

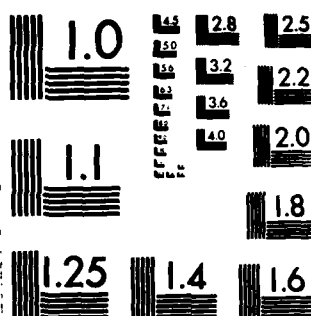
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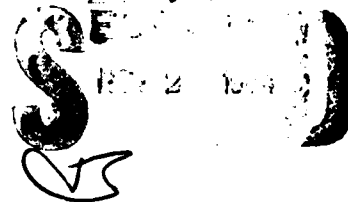
AD-A147 076

DANVERS RIVER BASIN
DANVERS, MASSACHUSETTS

MILL POND DAM

MA. 00161

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DECEMBER 1980

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

JUN 15 1981

NEDED-E

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Mill Pond Dam (MA-00161) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Mill Pond Dam would likely be exceeded by floods greater than 8 percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00161	2. GOVT ACCESSION NO. AD-A147076	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) M111 Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE December 1980
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18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Danvers River Basin Danvers, Mass.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) M111 Pond Dam is an ashlar faced stone wall dam with an upstream earth embankment. The dam is about 605 feet long, 12.6 feet high and has a crest width of 54 ft. The dam has been classified as having a high hazard potential. The recommended test flood ranges from a probable maximum flood (½ the PMF) to a full PMF. The dam is judged to be in generally fair condition.		

NEDED-E

Honorable Edward J. King

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. This report has also been furnished to the owner of the project, Town of Danvers, Danvers, MA.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for the cooperation extended in carrying out this program.

Sincerely,



C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer



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MILL POND DAM

MA - 00161

DANVERS RIVER BASIN

DANVERS, MASSACHUSETTS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.: MA 00161
Name of Dam: Mill Pond Dam
Town: Danvers
County and State: Essex County, Massachusetts
Stream: Crane Brook
Date of Inspection: 20 October 1980

BRIEF ASSESSMENT

Mill Pond Dam is an ashlar faced stone wall dam with an upstream earth embankment. The dam appears to have been constructed prior to 1880. The facility is used for recreational purposes and also to control flows to a small downstream impoundment used for process water.

The dam is about 605 ft. long, 12.6 ft. high and has a crest width of 54 ft. Sylvan Street is located on the crest of the dam. The downstream face of the dam is an ashlar masonry wall. The wall extends about 2.3 ft. above the roadway surface forming a parapet along the roadway. The dam has two spillways. The primary spillway is a box culvert located about 50 ft. left of the right abutment. An 8 ft. long stoplog structure is located just upstream of the spillway. The secondary spillway is a 3 ft. dia. metal pipe culvert, located about 200 ft. right of the left abutment. A 4.5 ft. long stoplog structure is located upstream of this spillway. There are no other outlets at the dam.

The reservoir is about 700 ft. long and the surface area of the reservoir at spillway crest level is about 6 acres. The drainage area above the dam is about 5.1 sq. mi. (3,264 acres) and the maximum storage to top of dam is about 322 acre-ft. Based on storage and height criteria, the size classification is small. Because a breach of the dam could affect a few homes, an apartment house and three local roadways, with the possible loss of a few lives, the dam has been classified as having a high hazard potential. Based upon the Guidelines, the recommended test flood ranges from a probable maximum flood ($\frac{1}{2}$ PMF) to a full PMF. A $\frac{1}{2}$ PMF (2,975 CFS) was selected as the most appropriate test flood for evaluation of this dam.

The test flood inflow is 2,975 CFS; the routed test flood outflow of 2,500 CFS would overtop the dam by about 1.4 ft. The spillways can pass about 400 CFS or about 16 percent of the routed test flood outflow without overtopping the dam.

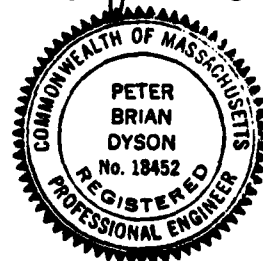
The dam is judged to be in generally fair condition. It has inadequate spillway discharge capacity. The present method for draining the pond in the event of high water is unsatisfactory because pulling the stoplogs by hand could be very difficult if there is a high head on the stoplog structure. Seepage was noted at the downstream toe of the dam. The concrete in the stoplog structures has spalled and there is minor erosion near the spillways on the upstream slope.

Within one year of receipt of this Phase I Inspection Report, the owner, the Town of Danvers should utilize the services of a registered professional engineer experienced in the design of dams and implement the results of his evaluations of the following: (1) perform a detailed hydrologic-hydraulic investigation to assess further the potential for overtopping the dam and the need for and the means to increase project discharge capacity; (2) the feasibility of replacing the stoplogs at the secondary spillway with a control valve to permit a more reliable method for drawing down the pond; (3) determine the need for making a seismic investigation of the dam and analysis by equivalent static load methods; (4) remove trees including root systems from within 10 ft. of toe of downstream wall and backfill with suitable compacted material; and (5) repair the spalled concrete on the upstream end of each spillway.

The owner should also implement the following operating and maintenance measures: (1) repair minor erosion of the embankment at the upstream end of both spillways; (2) repair spalling of the mortar joints on the downstream parapet wall; (3) replace the dislodged stones on the left wall of the right outlet channel; (4) remove brush growth to a distance of 10 ft. from the downstream toe of the dam on the right side of the right outlet channel; (5) monitor seepage at the downstream toe of the dam at point approximately 10 ft. right of the primary spillway outlet channel; (6) develop a formal surveillance and downstream emergency warning plan including round-the-clock monitoring during periods of heavy precipitation; (7) institute procedures for an annual technical inspection of the dam and appurtenant structures; and (8) implement a regular periodic maintenance program.



Peter B. Dyson
Project Manager



This Phase I Inspection Report on Mill Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.



ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

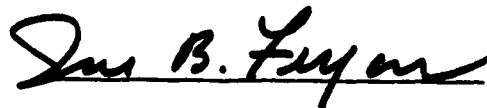


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division



JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, sub-surface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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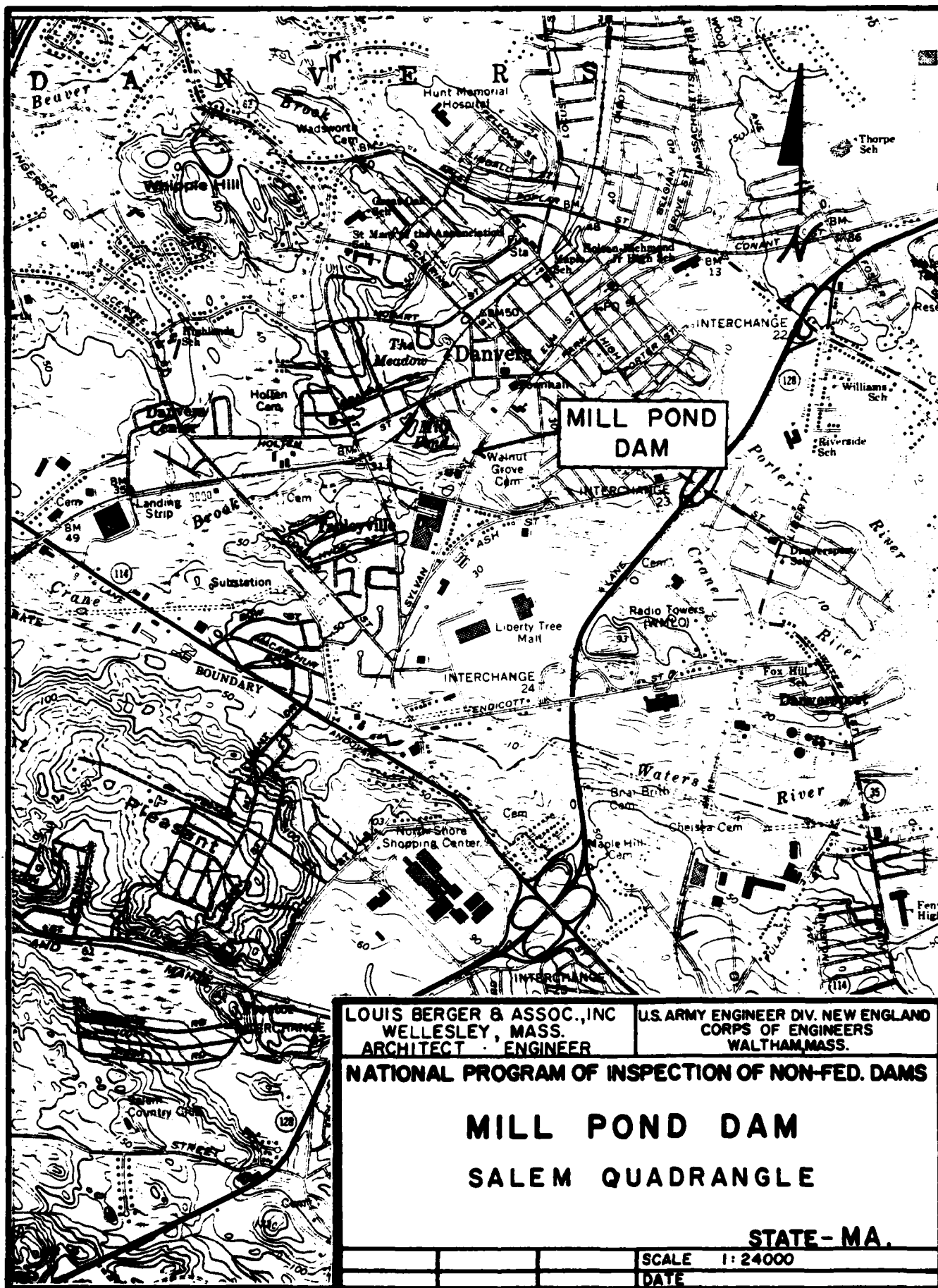
APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

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MILL POND DAM



OVERVIEW PHOTO



PHASE I INSPECTION REPORT

MILL POND DAM MA-00161

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 30 September 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0043, Job Change No. 1 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly, effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Mill Pond Dam is located in Essex County in the Town of Danvers in north-east Massachusetts. The pond is situated at the confluence of Crane Brook and Beaver Brook, and approximately 1.8 miles upstream from the confluence of Crane Brook and the Danvers River, and 3.6 miles upstream from Beverly Harbor. The dam is reached via Sylvan St. and is shown on U.S.G.S. Quadrangle, Salem, Massachusetts with coordinates approximately at N 42° 33' 34", W 70° 56' 32".

b. Description of Dam and Appurtenances

(1) Description of Dam. Mill Pond Dam is a 12.6 ft. high, 605 ft. long ashlar faced stone wall dam with an earthfill embankment upstream of the wall. The dam is constructed across a mildly sloping valley along Crane Brook. A paved roadway known as Sylvan St. passes along the entire length of the earthfill and is about 2.3 ft. below the top of the stone wall dam.

The crest of the earthfill has a width of about 54 ft. The downstream ashlar faced stone wall forms a parapet along the entire length of the dam. There is a low concrete curb wall on the upstream side of the dam which is nearly flush with the embankment. Upstream of this curb wall the dam has a $1\frac{1}{2}$ horizontal to 1 vertical grass covered earth slope.

(2) Spillways. There are two spillway facilities for Mill Pond Dam.

The primary spillway is a stone box culvert located through the dam about 50 ft. from the right abutment and is controlled by a stoplog structure on the upstream side of the culvert. The culvert is about 4.7 ft. high and 8.0 ft. wide and discharges into a manmade channel with 3.0 ft. high rubble masonry walls. The stoplog structure abuts the culvert entrance. It is of concrete construction and is fitted with wooden stoplogs. The weir length on the stoplog structure is 8.0 ft.

The secondary spillway is a 3.0 ft. dia. metal pipe culvert located through the dam about 200 ft. from the left abutment and is controlled by a stoplog structure on the upstream side. There is a short 9 ft. high by 4.5 ft. wide stone box structure between the pipe culvert and the stoplog structure. The stoplog structure abuts the stone box. It is constructed of concrete and is fitted with wooden stoplogs. The weir length of the stoplog structure is 4.5 ft.

The primary and secondary spillway facilities can be used to draw the pond down. The stoplogs at the primary spillway extend downward to elevation 15.8 and the stoplogs at the secondary spillway extend downward to elevation 11.2. There are no other regulating outlets at the dam.

c. Size Classification. Mill Pond Dam has a hydraulic height of about 12.6 ft. above downstream level, and impounds a normal storage of about 25 acre-ft. to spillway crest elevation 18.5 and a maximum of about 322 acre-ft. to top of dam. In accordance with the size and capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, the project falls into the small category on the basis of capacity and is therefore classified accordingly. A small size dam is one which has a height less than 25 ft. and a storage capacity greater than 50 ac.-ft. but less than 1000 ac.-ft.

c. Hazard Classification. A breach failure of Mill Pond Dam would release water down Crane Brook, into Crane Pond on Crane Brook, into the Danvers River and thence into Beverly Harbor. Immediately below the dam Crane Brook traverses through a cemetery and then crosses under Purchase St. and Ash St. at a point about 1,400 ft below the dam. In the area of Purchase and Ash Streets it is estimated 5 houses will receive about 3 ft. of flooding and an apartment house will receive about 1 ft. of flooding due to the breach. In addition it is assumed Sylvan St. will be washed out and Purchase St. and Ash St. will be flooded. It appears that none of the habitable

structures will be flooded under the prefailure conditions. Since a small number of habitable structures will be flooded and there will be appreciable economic loss as well as the possible loss of more than a few lives in accordance with the Recommended Guidelines for Safety Inspection of Dams, the project has been classified as having a high hazard potential.

e. Ownership. Mill Pond Dam is owned by the Town of Danvers, Massachusetts, Danvers Town Hall, Danvers Massachusetts, 01923. Telephone - 617-777-0001.

f. Operator. Mr. Newton H. Sweet, Director of Public Works, Danvers Town Hall, Danvers, Massachusetts 01923, Telephone - 617-777-0001.

g. Purpose of Dam. The dam is used to impound water for recreational purposes and industrial use. Water is released from the dam to a small impoundment located between Purchase and Ash Streets where process water is pumped from the small impoundment for industrial use.

h. Design and Construction History. It is not known by whom the dam was designed and constructed. It is believed that the dam was built sometime prior to 1880.

i. Normal Operating Procedures. The only operating facilities at the dam are the stoplog structures at the primary and secondary spillways. Described below is the "Usual Operation Policy" for the dam:

"From ice-out in spring until mid-November, "normal" water level is maintained, except under the following conditions:

- a. Upon receiving a flash flood warning, either from the National Weather Service or the Town's private weather service, the Town removes flashboards to lower the effective spillway elevation by 1 to 1½ feet.
- b. Water may be released (by removing flashboards) upon request of Creese and Cook Company for additional water. Creese and Cook Company have rights to the water and use it for processing purposes. They pump from a small pond at the intersection of Purchase and Ash Streets. (Approximately 1/3 mile downstream).

From mid-November to spring ice-out, the water level is maintained about 1 to 1½ feet below "normal" to provide additional flood storage capacity for winter storms."

1.3 Pertinent Data

a. Drainage Area. The drainage area encompasses a total of about 5.1 sq. mi. (3,264 acres). The pond has a surface area of 10 acres. The longest circuitous stream course contributing to the pond is about 3.6 miles long with an elevation drop of about 111 ft., or at a slope of about 40 ft./mile and rises from elevation 19.5 at normal pool to elevation 130. The drainage area has a length of about 2.4 miles and an average width of about 2.2 miles. Two major water courses drain the area; Beaver Brook drains the northern sector; and, Crane Brook drains the southern sector. The two water courses join together at Mill Pond and then Crane Brook continues downstream for a distance of about 1600 ft. where it becomes a tidal estuary. The drainage area is predominately urbanized and densely populated in the lower reaches. However, there are open fields and forested areas in the upper reaches. The western sector is traversed by U.S. Route 1 and Interstate Route 95.

b. Discharge at Damsite

(1) Outlet Works Conduit. Both the primary and secondary spillways at Mill Pond can be used to drain the pond in the event of an emergency, provided the head at each spillway is not too high to prevent removal of the stoplogs by hand. There is no other facility for drawing down the pond. The bottom of the primary spillway structure is at elevation 15.8 and the bottom of the secondary spillway is at elevation 11.2. The rate of drawdown would be dependent on the number of stoplogs removed and the rate at which they were removed.

(2) Maximum Known Flood at Damsite. No records are available of flood inflows into Mill Pond, nor of spillway releases during such inflows. It was reported by the owner's representative that about 6 or 7 years ago the surcharge in the pond nearly reached the level of the roadway when the stoplogs in the spillways were not removed below their normal elevation prior to a major storm. There were no reported problems.

(3) Ungated Spillway Capacity at Top of Dam. With the top of stoplogs assumed to be at elevation 18.5 ft., the ungated capacity of the Primary Spillway is 214 cfs and of the Secondary Spillway 145 cfs. If all the stoplogs were removed the capacity of the Primary Spillway is 500 cfs and of the Secondary Spillway 154 cfs. when the pond water surface level is at top of dam elevation 26.6 ft.

(4) Ungated Spillway Capacity at Test Flood Elevation. With the top of stoplogs assumed to be at elevation 18.5 ft., the ungated spillway capacity is 400 CFS when the pond water surface level is at test flood elevation 28.0 ft.

(5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

(6) Gated Spillway Capacity at Test Flood Elevation. Not applicable.

(7) Total Spillway Capacity at Test Flood Elevation. The total spillway discharge at the test flood elevation is the same as (4) above, 400 cfs at test flood elevation 28.0.

(8) Total Project Discharge at Top of Dam. The total project discharge at top of dam is the same as (3) above, 360 CFS at elevation 26.6 ft.

(9) Total Project Discharge at Test Flood Elevation. With the top of stoplogs assumed to be at elevation 18.5 ft., the total project discharge is 2,500 CFS and the water surface elevation of the pond is at 28.0 ft.

c. Elevations (Ft. N.G.V.D. assumed from U.S.G.S. Topo Map)

- (1) Streambed at Toe of dam - 14.0
- (2) Bottom of Cutoff - Unknown
- (3) Maximum tailwater - Unknown
- (4) Normal pool - 19.5
- (5) Full flood control pool (Not applicable)
- (6) Spillway crest - Varies from 18.5 in fall, winter, and spring to 20.0 in summer
- (7) Design surcharge (original design) - Unknown
- (8) Top of roadway - 24.3
- (9) Top of dam - 26.6 (top of parapet wall)
- (10) Test flood surcharge - 28.0

d. Reservoir (length in feet)

- (1) Normal pool - 700
- (2) Flood control pool - Not applicable
- (3) Spillway crest pool - 700
- (4) Top of Dam - 4,000
- (5) Test flood pool - 4,300

e. Storage (acre-ft.)

- (1) Normal pool (El. 19.5) - 30
- (2) Flood control pool - not applicable
- (3) Spillway crest pool (EL. 18.5) - 25
- (4) Top of dam (El. 26.6) - 322

(5) Test flood pool (El. 28) - 408

f. Reservoir Surface (acres)

(1) Normal pool (El. 19.5) - 10

(2) Flood control pool - Not applicable

(3) Spillway crest (El. 18.5) - 6

(4) Test flood pool (El. 28) - 87

(5) Top of dam (El. 26.6) - 74

g. Dam

(1) Type - Earth embankment with downstream ashlar masonry wall.

(2) Length - 605 ft.

(3) Height - 12.6 ft.

(4) Top Width - 54 ft.

(5) Side Slopes - U/S $1\frac{1}{2}$ horizontal to 1 vertical
D/S vertical wall

(6) Zoning - Unknown

(7) Impervious Core - Unknown

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway - Primary

(1) Type - Box culvert with stoplog structure upstream

(2) Length of weir - 8.0 ft.

(3) Crest elevation - 18.5

(4) Gates - None

(5) Upstream channel - Pond

(6) Downstream channel - 10 ft. wide manmade channel with
3 ft. high vertical rubble walls

Spillway - Secondary

- (1) Type - 3 ft. dia. pipe culvert with stoplog structure upstream
- (2) Length of weir - 4.5 ft.
- (3) Crest elevation - 18.5
- (4) Gates - None
- (5) U/S Channel - Pond
- (6) D/S Channel - 12 ft. wide manmade channel with 3 ft. high vertical rubble walls.

j. Regulating Outlets

Both the primary and secondary spillways can be used as regulating outlets. By removing stoplogs in the primary spillway the pond can be drawn down to elevation 15.8 ft. and by removing stoplogs in the secondary spillway which acts as a low level outlet the pond can be drawn down to elevation 11.2 ft. There are no other regulating outlets at the dam.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No data on the design of the dam or appurtenances has been recovered. Two plans were obtained from the Town of Danvers and are included in Appendix B. One plan shows the dam embankment in plan view, the other is a profile of the roadway along the crest of the dam. The second plan also shows a profile of a sewer located in the dam embankment. In the course of the inspection, measurements were taken and a sketch plan and profile layout of Mill Pond Dam prepared. This plan is also included in Appendix B.

2.2 Construction Data

No records or correspondences have been found regarding construction data.

2.3 Operation Data

No engineering operational data were disclosed.

2.4 Evaluation of Data

a. Availability. There was limited engineering data available. The basis of the evaluation presented in this report is principally the visual observations of the inspection team.

b. Adequacy. The lack of in-depth engineering data did not allow for a definite review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. Not applicable

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Mill Pond Dam took place on 20 October 1980. On that day the water level was about 1 in. above the stoplogs at the primary spillway and the discharge was estimated to be about 1 cfs. There was a small amount of seepage issuing from the toe of the ashlar masonry wall at one location. The upstream slope is in need of minor repair. The concrete on the spillway stoplog structures is spalled and the left wall of the primary spillway discharge channel is in need of repair. Brush growth is abundant downstream of the ashlar masonry wall. There was no evidence of any major problems and in general the physical condition of the dam was judged to be good.

b. Dam. Mill Pond Dam is a cemented ashlar faced stone wall dam with an upstream earthfill. The crest length is about 605 ft. and the maximum height is about 12.6 ft. The crest width is about 54 ft., and a paved roadway, (Sylvan St.) and a paved sidewalk are located along the entire length of the earthfill about 2.3 ft. below the top of dam. The downstream wall forms a parapet along the road. A low concrete curb wall is located on the upstream side of the dam between the sidewalk and the upstream embankment slope. The upstream slope of the earth embankment is about $1\frac{1}{2}$ horizontal to 1 vertical. Photo nos. 1 and 2 show the crest of the embankment taken from the left and right abutments respectively. In general the upstream slope appears to be well maintained, but there is erosion of the slopes in the immediate vicinity and on both sides of the two spillway structures. Some filling and slope protection is advisable in this area.

Photo no. 3 is a view of the downstream wall looking toward the left abutment. The wall appears to be in very good condition with only minor spalling of the joints. Most of the spalling is on the upstream side of the wall adjacent to the roadway as shown in photo no. 4. There was a small amount of clear seepage estimated at 0.1 gpm issuing from the downstream toe of the ashlar faced masonry wall at a point approximately 10 ft. right of the primary spillway. The seepage is shown in photo no. 5. There is considerable brush growth immediately downstream of the ashlar masonry wall on the right side of the dam. At the time of the inspection the brush growth did not appear to be interfering or undermining the wall in anyway, however, it should be removed in the vicinity of the wall. The alignment, both horizontally and vertically of the downstream wall is good. The condition of the pavement at the crest of the embankment is good and the horizontal and vertical alignment of the embankment is good. There is no evidence of cracking of the pavement. The concrete capped curb wall on the upstream side of the dam is in poor alignment due to upward movement and some settling. However, this does not appear to be a problem since the embankment is about 50 ft. wide. It should

be noted a gravity sewer line, gas, and water lines are located in the dam embankment. Roadway drainage structures are also located in the embankment.

c. Appurtenant Structures. There are two spillway facilities for the dam. The primary spillway is located about 50 ft. left of the right abutment and is a stone box culvert with an upstream concrete stoplog structure fitted with wooden stoplogs. The culvert is about 4.7 ft. high and 8 ft. wide and the weir length of the stoplog structure is 8.0 ft. Photo no.'s 6 and 7 show the inlet and outlet ends of the spillway, respectively. There is minor erosion of the embankment slopes adjacent to the spillway. The general condition of the stoplog structure is fair to good. There is some minor spalling of the concrete, but no visible reinforcing, and no signs of efflorescence. The spillway discharges into a 10 ft. wide manmade channel with 3 ft. high rubble walls. At a point about 50 ft. downstream of the culvert the left discharge channel training wall has failed and there is significant erosion in the area of the failure. (see Appendix C, Photo No. 8). The wall is in poor condition.

The secondary spillway is located about 200 ft. right of the left abutment. It is a 3 ft. dia. pipe culvert with an upstream concrete stoplog structure. Between the pipe and the stoplog structure is a short stone box culvert. The stoplog structure is fitted with wooden stoplogs and has a weir length of 4.5 ft. Photo no's 9 and 10 show the inlet and outlet end of the spillway, respectively. There is minor erosion of the embankment slopes adjacent to the spillway. The concrete stoplog structure has deteriorated and some repairs to the spalled concrete are necessary. There is no visible reinforcing in the concrete. The general condition of the secondary spillway is fair.

There are no other regulating outlets at Mill Pond Dam.

d. Reservoir Area. The shoreline around the pond both right and left of the dam appears to be in good condition, with no evidence of any instability or movement of the slopes.

e. Downstream Channel. The two spillways discharge into manmade channels with vertical rubble walls which pass through Walnut Grove Cemetary. About 600 ft. downstream of the dam the waterways join together to form one stream. About 1,400 ft. below the dam, Crane Brook passes under Purchase St. and then Ash St. Between the two streets there is a small dam where water is impounded and pumped through a nearby pumping station to an industrial site for process use. Beyond the small dam at Purchase and Ash Streets, Crane Brook is a tidal estuary having a relatively wide channel. About 4,000 ft. beyond Mill Pond Dam, Crane Brook flows through an estuary about 300 ft. wide which was once controlled by tidal gates. The tidal gates are no longer used and a large tidal flat now exists in this area. About 2,700 ft. beyond the old tidal gate site Crane Brook joins the Porter River to form the Danvers River.

3.2 Evaluation

The visual inspection has adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam and appurtenant works are judged to be in good physical condition.

A clear seep estimated 0.1 gpm was found at the toe of the downstream stone wall. There was minor spalling of the cement in the stone wall, minor spalling of the concrete in the primary spillway stoplog structure and severe spalling of the concrete in the secondary spillway stoplog structure. There was minor erosion of the upstream slope near the spillway facilities and a heavy growth of vegetation at the toe of the stone wall on the right side of the dam. The left discharge channel training wall of the primary spillway has failed. There is no regular periodic maintenance program for the dam.

The existing method for draining the pond in the event of high water is unsatisfactory because pulling of stoplogs by hand could be very difficult if there is a high head on the stoplog structures.

SECTION 4 - OPERATIONAL AND MAINTAINANCE PROCEDURES

4.1 Operation Procedures

a. General. The dam is owned and operated by the Town of Danvers. It is operated as a recreational facility and for storing process water for a plant located downstream.

b. Description of any Warning System in Effect. No warning system is in effect at Mill Pond Dam.

4.2 Maintenance Procedures

a. General. There is no documented regular periodic maintenance program in effect at Mill Pond Dam.

The grass slopes on the upstream side of the dam are mowed four or five times per year. There are several other items which require periodic maintenance, such as: maintainance of the stoplog structures; maintainance of the spillway discharge channels; surveillance of the downstream wall regarding seeps; and, removal of brush growth from the toe of the downstream wall.

b. Operating Facilities. The only operating facilities at the dam are the stoplog structures at the spillways. Maintenance of these facilities is said to be performed as necessary.

4.3 Evaluation

Overall maintenance of the dam is good.

Specific maintainance items are evaluated as follows: the upstream slope is generally well maintained but is in need of minor repair around the outlet structures; the concrete stoplog structures have become spalled and are in need of repair; there is minor spalling in the cement joints of downstream ashlar masonry wall; the area immediately below the downstream wall should be cleared of vegetation; and the spillway discharge channel at the primary spillway should be repaired. The owner should establish a formal downstream warning system for the dam in the event of an emergency. There is no regular periodic maintenance program.

SECTION 5 - EVALUATION OF HYDRAULIC AND HYDROLOGIC FEATURES

5.1 General

Mill Pond Dam is an earth embankment with a downstream ashlar masonry wall which supports a paved roadway across the entire length of its crest. The downstream wall extends about 2.3 ft. above the roadway forming a parapet along the downstream side of the roadway. The dam impounds about 25 acre-ft. of water when the stoplogs are at elevation 18.5. It has an additional 150 acre-ft. of capacity in its surcharge space to the top roadway and a total of 297 acre-ft. of surcharge space to the top of the parapet. The dam is basically a low surcharge-low spillage facility used to impound water for recreational use and to control flowage to a downstream pumping station where process water is pumped from Crane Brook for industrial use. Two culvert spillways, each with an upstream stoplog structure, control the outflows from Mill Pond. During the summer months the stoplogs are maintained at elevation 19.5 to elevation 20.0 which is about 1 to 1.5 ft. higher than normally maintained during late fall, winter and spring months or at times when flash flood warnings are received. In the reservoir routing performed in this section, the stoplogs and pond were assumed to be at elevation 18.5 ft. at the start of the routing. With the pond level at the top of the parapet the spillways can discharge about 400 CFS.

The general topographic characteristics of the 5.1 sq. mi. (3,264 acres) drainage area is best described as flat and coastal, though scattered high hills are located within the area. The terrain rises from about elevation 20 ft. to elevation 250 ft. The area is heavily developed, particularly in the lower reaches. Two main water courses drain the area, Beaver Brook and Crane Brook. They join together at Mill Pond.

5.2 Design Data

No hydrologic computations or hydraulic data has been recovered for the dam.

5.3 Experience Data

No records are available in regard to past operation of the dam, nor of surcharge encroachments and flows through the spillways. It was reported that a few years ago the water level in the pond nearly reached the roadway surface on the crest of the dam. This event occurred at a time when the stoplogs were not lowered below their normal summer elevation prior to a major storm event.

5.4 Test Flood Analysis

The test flood used to evaluate the hydrologic and hydraulic capacity of Mill Pond Dam was selected in accordance with the method presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as small in size with a significant hazard potential, the recommended test flood ranges from a magnitude of 100 years to a $\frac{1}{2}$ PMF, (probable maximum flood). Because habitable structures are located a short distance downstream a test flood equal to $\frac{1}{2}$ PMF was selected.

Precipitation data were obtained from Hydrometeorological Report No. 51, which for the Northeast Massachusetts area approximates 25 inches of 6 hour maximum rainfall over a 10 square mile area. This value was then reduced by 20 percent to allow for basin size, shape and fit factors and further reduced by 0.4 in. for infiltration losses. The 6 hour rainfall was distributed into one hour incremental periods as suggested in Corps of Engineers Publication EC 1110-2-1411.

A triangular incremental unitgraph was assumed for the inflow hydrograph using a computed lag time of 8.32 hours to derive a time-to-peak for the triangular hydrograph of 7.23 hours (see computations on sheets D-8 thru D-10, Appendix D.) indicating a peak inflow for a full PMF of about 5,950 cfs or a CSM of about 1,170. The full PMF was divided by two to arrive at a test flood value of 2,975 CFS.

Discharge tables and curves for the spillways and for over the top of the dam are shown on sheets D-4 thru D-7, Appendix D. For determining surface areas and surcharge capacities planimetered areas were taken from contours delineated on 1:25,000 U.S.G.S. sheets.

A flood routing was performed for the test flood. At the beginning of the test flood routing it was assumed the stoplogs in both spillways were at elevation 18.5 as was the water surface in the pond. Results of this routing are shown on sheets D-15 and D-17, Appendix D, and are summarized as follows:

<u>Flood Magnitude</u>	<u>Test Flood Inflow (cfs)</u>	<u>Maximum Res. El. (ft. NGVD)</u>	<u>Max. Head Over Top of Dam (ft.)</u>	<u>Routed Test Flood Outflow (cfs)</u>
$\frac{1}{2}$ PMF	2,975	28.0	1.4	2,500

From the above table, it can be seen that the project will not pass the routed test flood without over topping the dam by 1.4 ft. The project can handle about 16 percent of the routed test flood without overtopping the dam.

5.5 Dam Failure Analysis

A breach owing to structural failure of the embankment is a possibility. A breach analysis was performed for the dam using a breach width of 20 percent of the dam length at midheight equal to 75 ft. and the pond level at top of dam, an outflow of 6,000 cfs, which includes about 400 cfs from spillway would be realized.

A breach failure of the dam would release water down Crane Brook to the Danvers River. Immediately below the dam the flood waters would partially inundate the Walnut Grove Cemetery. At a point about 1,400 ft. below the dam Crane Brook flows through an 8 ft. wide by 3.5 high box culvert under Purchase St. and then under Ash St. It is estimated the breach discharge will be reduced to about 4,700 CFS at Purchase and Ash Streets and the streets will be overtopped by about 5 ft. of water. In this area it is estimated about 5 homes will be flooded by about 3 ft. of water and one apartment house will be flooded by about 1 ft. of water. Beyond Ash St. Crane Brook becomes a tidal estuary and the flood waters should become significantly reduced in a tidal basin southeast of Route 128. It is estimated no significant flooding will take place beyond the vicinity of Purchase and Ash Streets. It is also estimated no habital structures will be flooded due to the prefailure conditions although Purchase and Ash Streets will receive minor flooding under the prefailure condition.

In summary, a small number of homes, an apartment house and three local roadways are within the area of potential flooding, and there is the potential for loss of a few lives. Therefore, in accordance with the Recommended Guidelines for Safety Inspection of Dams, the project has been classified as having a high hazard potential. Sheet D-18, Appendix D shows the area of potential flooding described above.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The Mill Pond Dam is in good physical condition at the present time as revealed by the field inspection of 20 October, 1980. However, there are several items of a remedial nature which were observed during the field inspection and which will require treatment as outlined in Section 7.

6.2 Design and Construction Data

There are no definitive plans of the embankment and two outlet structures. Data on typical cross sections of the granite block masonry wall on the downstream face of the dam are not available. Calculations pertaining to the stability of the embankment gravity walls are also unavailable.

6.3 Post-Construction Changes

There are no records of any postconstruction changes made to the dam or spillway over the course of its history. However, a survey dated 1879 shows the presence of a former mill building connected to the left abutment outlet structure at its downstream end. This building is no longer in existence.

6.4 Seismic Stability

The dam is located in Seismic Zone No. 3. Phase I Guidelines Recommend, as a minimum, that suitable analysis made by conventional equivalent static load methods should be on record for dams in Zone 3. As far as can be determined, no such analysis has been made.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Mill Pond Dam is judged to be in fair condition. The deficiencies reveal further investigations should be carried out and some remedial work is needed. The major concerns revealed by the Phase I investigation are (1) the spillways will only pass about 16 percent of the routed test flood outflow; and (2) in the event of an emergency it may not be possible to remove the stoplogs due to high water levels.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definite review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the owner, the Town of Danvers, should utilize the services of a competent registered professional engineer to make investigations and studies of the following, and, if proved necessary, to design appropriate remedial works; (1) Perform a detailed hydrologic-hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity; (2) Study the feasibility of replacing the stoplogs at the secondary spillway with a control valve to permit a more reliable method for drawing down the pond; (3) Determine the need for making a seismic investigation of the dam and analysis by conventional equivalent static load methods; (4) Remove trees including root systems from within 10 ft. of toe of downstream wall and backfill with suitable compacted materials; and (5) Repair the spalled concrete at the upstream end of each spillway.

7.3 Remedial Measures

a. Operation and Maintenance Procedures:

(1) Repair minor erosion of the embankment at the upstream end of both spillways, using a suitable compacted fill for this purpose, and re-establish and maintain a protective growth.

1

(2) Repair spalling of the mortar joints on the downstream parapet wall.

(3) Replace the dislodged stones on the left training wall of the right outlet channel approximately 50 feet downstream of the dam. Repair erosion behind wall and re-establish and maintain a protective growth.

(4) Remove brush growth to a distance of 10 feet from the downstream toe of the dam.

(5) Monitor seepage at the downstream toe of the dam at a point approximately 10 feet right of the right outlet channel. This should be on a regular monthly basis and following periods of heavy rainfall.

(6) Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation. The plan will also include round-the-clock monitoring of the project during periods of heavy precipitation.

(7) Institute procedures for an annual technical inspection of the dam and appurtenant structures.

(8) Implement a regular periodic maintenance program.

7.4 Alternatives

There appear to be no practical alternatives to the above recommendations.

Appendix A
Inspection Checklist

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Mill Pond Dam DATE 20 October 1980
OWNER Town of Danvers TIME 3:00 pm
WEATHER Cloudy, 55°F
W.S. ELEV. 19.6 U.S. DN.S.

INSPECTION PARTY

<u>A/E REPRESENTATIVES</u>	<u>OWNER'S REPRESENTATIVES</u>
1. <u>Pasquale E. Corsetti</u>	1. <u>John Crofts</u>
2. <u>Roger F. Berry</u>	2. _____
3. <u>Carl J. Hoffman</u>	3. _____
4. <u>William S. Zoino</u>	4. _____
5. _____	5. _____

<u>PROJECT FEATURE</u>	<u>INSPECTED BY</u>	<u>REMARKS</u>
1. <u>Hydrologics</u>	<u>Roger F. Berry</u>	<u>LBA</u>
2. <u>Hydraulics/Structures</u>	<u>Carl J. Hoffman</u>	<u>LBA</u>
3. <u>Soils Geology</u>	<u>William S. Zoino</u>	<u>GZA</u>
4. <u>General Features</u>	<u>Pasquale E. Corsetti</u>	<u>LBA</u>
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____

LBA - Louis Berger & Associates, Inc.
GZA - Goldberg-Zoino & Associates, Inc.

PERIODIC INSPECTION CHECKLIST

PROJECT Mill Pond Dam DATE 20 October 1980
 PROJECT FEATURE Embankment & Wall NAME _____
 DISCIPLINE Soils/Geology NAME William Zoino

AREA EVALUATED	CONDITIONS
<u>DIKE EMBANKMENT</u>	
Crest Elevation	Wall - 26.6 ft. Embankment 24.3 ft.
Current Pool Elevation	19.6
Maximum Impoundment to Date	Unknown
Surface Cracks	None
Pavement Condition	Good
Movement or Settlement of Crest	None
Lateral Movement	Minor movement upstream, capstones, crest of upstream slope
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Minor erosion of embankment-upstream slope at each outlet structure
Indications of Movement of Structural Items on Slopes	Minor displacement of capstone on up- stream granite wall.
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	None
Rock Slop Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Minor seepage -.1 gpm-downstream toe 10 ft. right of right outlet channel.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

Note: Heavy brush growth downstream toe at right abutment

PERIODIC INSPECTION CHECKLIST

PROJECT Mill Pond Dam DATE 20 October 1980
 PROJECT FEATURE Principal Spillway NAME _____
 DISCIPLINE Hydraulics/Structures NAME Carl Hoffman

AREA EVALUATED	CONDITIONS
----------------	------------

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel	No approach channel
General Condition	N/A
Loose Rock Overhanging Channel	N/A
Trees Overhanging Channel	N/A
Floor of Approach Channel	N/A
b. Weir and Training Walls	
General Condition of Concrete	Fair to good
Rust or Staining	None
Spalling	Minor
Any Visible Reinforcing	No
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Yes
Floor of Channel	Granite Paved for 75 ft.
Other Obstructions	Left wall partially collapsed and minor debris.

PERIODIC INSPECTION CHECKLIST

PROJECT Mill Pond Dam DATE 20 October 1980

PROJECT FEATURE Secondary Spillway NAME _____

DISCIPLINE Hydraulics/Structures NAME Carl Hoffman

AREA EVALUATED

CONDITIONS

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

- | | |
|--------------------------------|---------------------|
| a. Approach Channel | No approach channel |
| General Condition | N/A |
| Loose Rock Overhanging Channel | N/A |
| Trees Overhanging Channel | N/A |
| Floor of Approach Channel | N/A |
| b. Weir and Training Walls | |
| General Condition of Concrete | Fair |
| Rust or Staining | Minor |
| Spalling | Yes |
| Any Visible Reinforcing | No |
| Any Seepage or Efflorescence | Minor seepage |
| Drain Holes | None |
| c. Discharge Channel | |
| General Condition | Fair |
| Loose Rock Overhanging Channel | None |
| Trees Overhanging Channel | Yes |
| Floor of Channel | Gravel |
| Other Obstructions | None |

PERIODIC INSPECTION CHECKLIST

PROJECT Mill Pond Dam DATE 20 October 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
----------------	------------

Dike Embankment	N/A
-----------------	-----

Outlet Works - Intake Channel and Intake Structure	N/A
---	-----

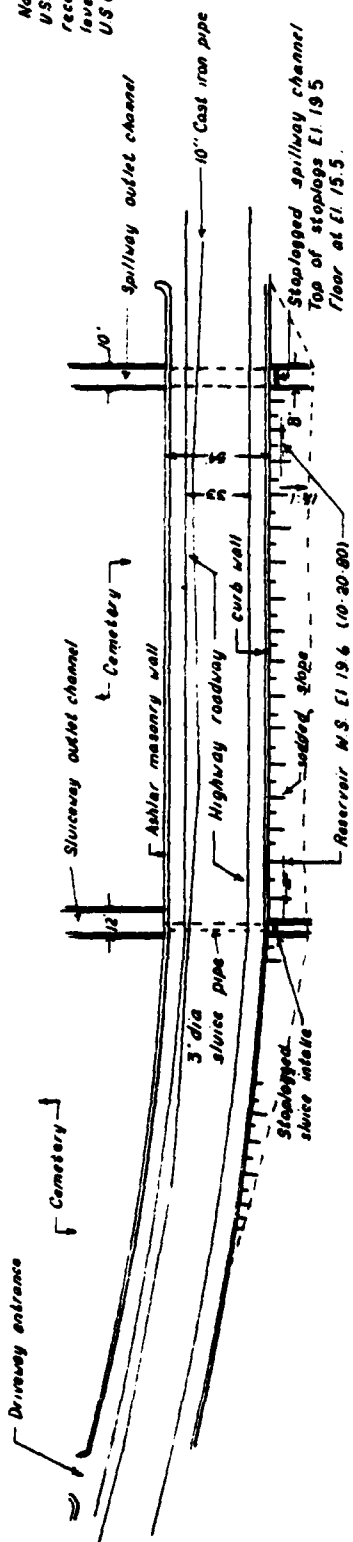
Outlet Works - Transition and Conduit	N/A
--	-----

Outlet Works - Control Tower	N/A
------------------------------	-----

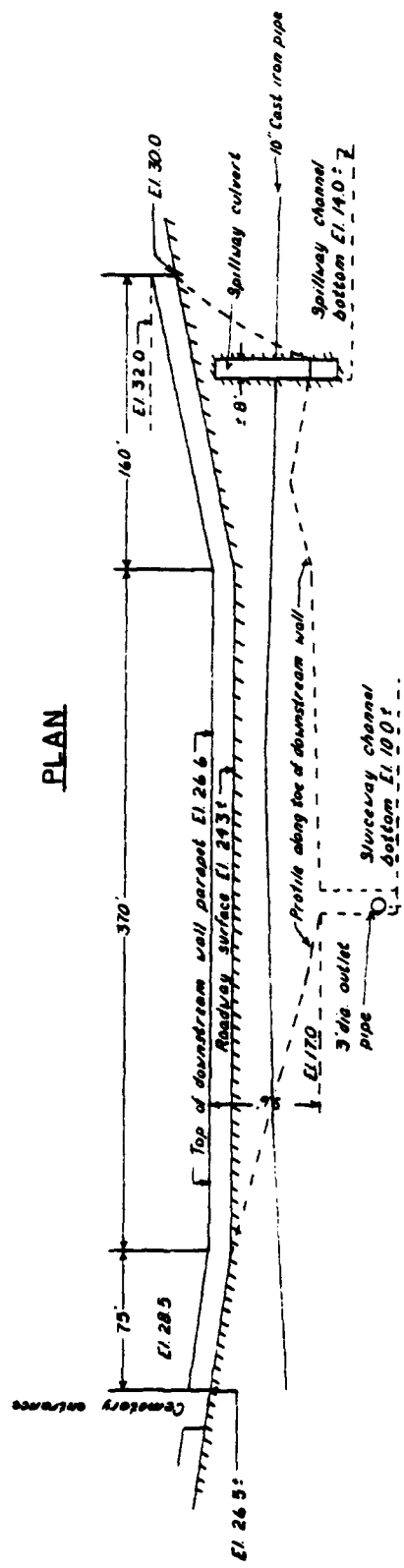
Outlet Works - Service Bridge	N/A
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Appendix B
Engineering Data

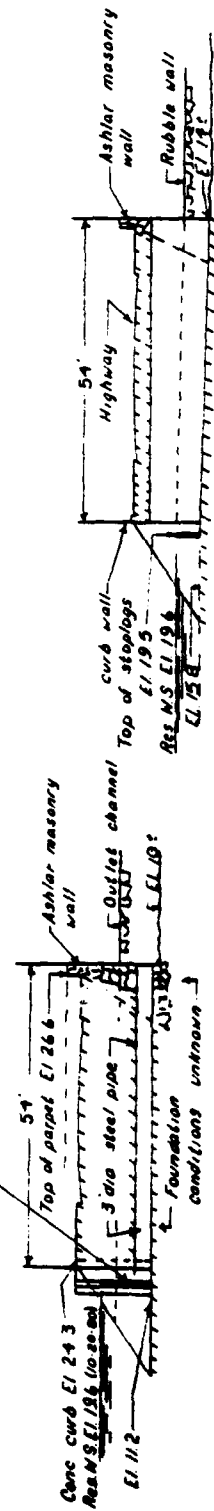
Note: Elevations shown are
USGS msl datum Existing
record drawings show
levels 4'48" lower than
USGS datum



PLAN



PROFILE ALONG AXIS OF DAM



SECTION THRU SLUICE

SECTION THRU SPILLWAY

MILL POND DAM
AT
DANVERS

D 5 - 2
DANVERS
5-5-71-4

L. E. WILKINSON

6/29/71

3

INTERSECTION OF SYLVAN ST. & POND ST. - SYLVAN STREET
ACTUALLY RUNS ACROSS THE OLD DAM SITE.

TOWN OF DANVERS (PARK DEPT.)

PLEASURE POND

EARTH WITH CONCRETE CAPPED MASONRY WALL ON
NORTH WEST SIDE - MASONRY WALL DOWN STREET SIDE - PAVED ROAD LENGTH OF
10.0 FT. ±

250.0 FT. ±

50.0 FT. ±

10 ACRES

5.4 ±

LEVEL

WATER 14'-10" BELOW TOP OF CONCRETE WALL
OF DAM TO DAY AT NORTHEAST SPILLWAY. WATER LEVEL 6'-8" BELOW
TOP OF CONCRETE WALL OF DAM TO-DAY AT SOUTH WEST SPILLWAY

THIS DAM NO HAZARD TO LIFE OR PROPERTY
TWO GOOD OUTLETS ARE FUNCTIONING WELL AND THE
DAM IS SO WIDE THAT IT COULD NOT POSSIBLY FAIL BY
COLLAPSING.



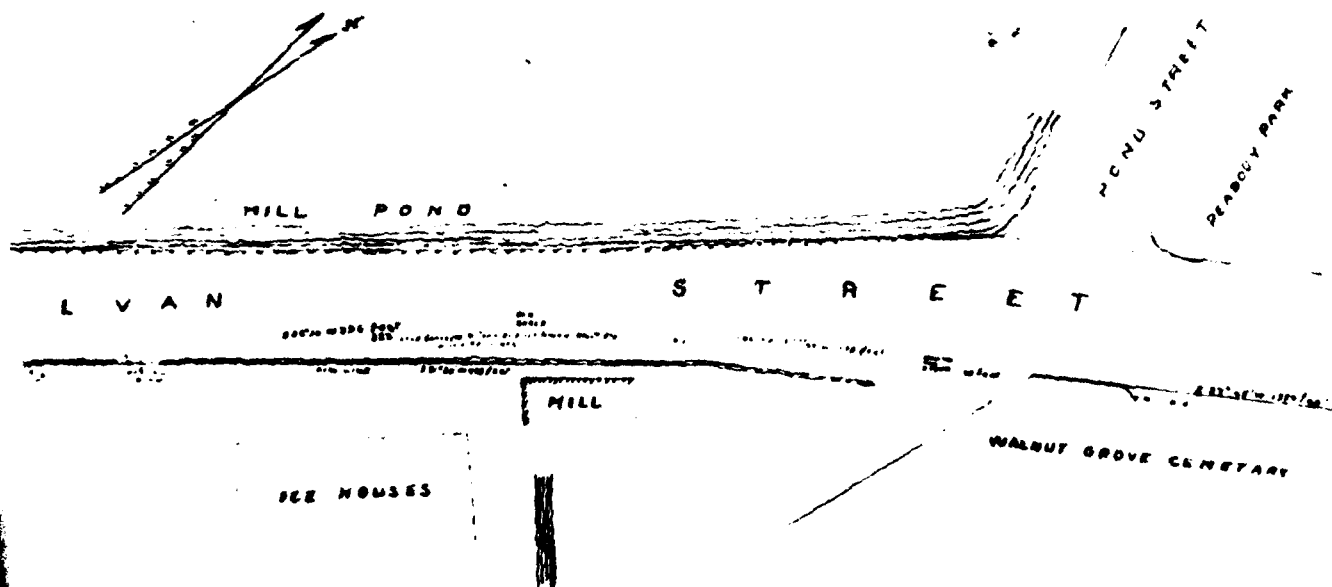
Town of Danvers

Mill Pond Dam

Usual Operation Policy

1. From ice-out in spring until mid-November, "normal" water level is maintained, except under the following conditions:
 - a. Upon receiving a flash flood warning, either from the National Weather Service or the Town's private weather service, the Town removes flashboards to lower the effective spillway elevation by 1 to 1½ feet.
 - b. Water may be released (by removing flashboards) upon request of Creese and Cook Company for additional water. Creese and Cook Company have rights to the water and use it for processing purposes. They pump from a small pond at the intersection of Purchase and Ash Streets. (Approximately 1/3 mile downstream).
2. From mid-November to spring ice-out, the water level is maintained about 1 to 1½ feet below "normal" to provide additional flood storage capacity for winter storms.
3. "Normal" water level is approximately the existing level.

For additional information on operating procedures for this dam, contact the Town of Danvers, Director of Public Works, Newton H. Sweet, Jr., at the Danvers Town Hall, (Tel. (617) 777-0001).

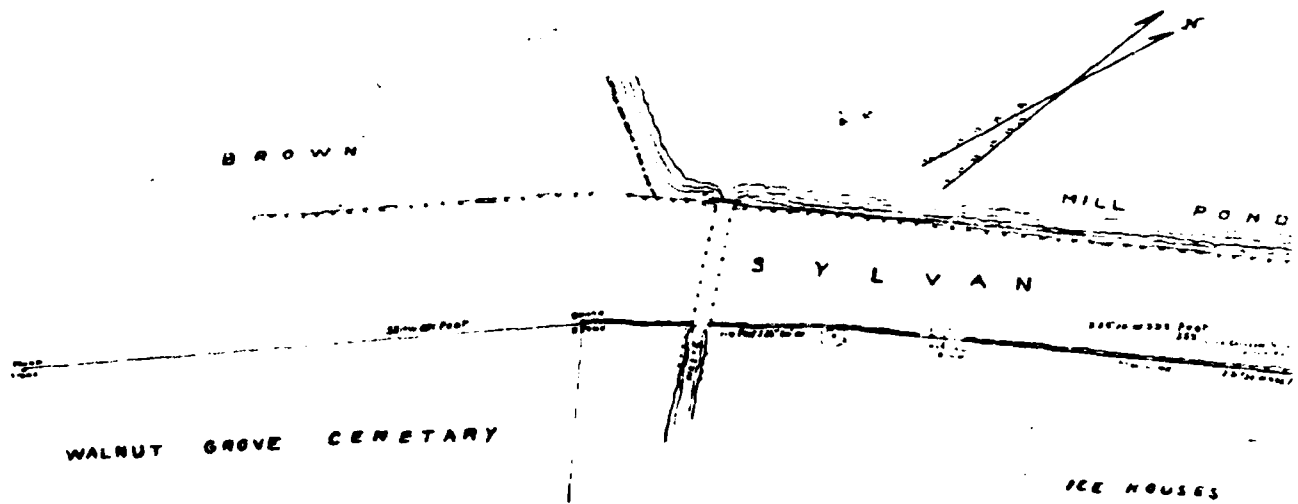


COUNTY OF ESSEX
RECORD NUMBER
1465
SHEET 1 OF 1
SYLVAN STREET

B-5

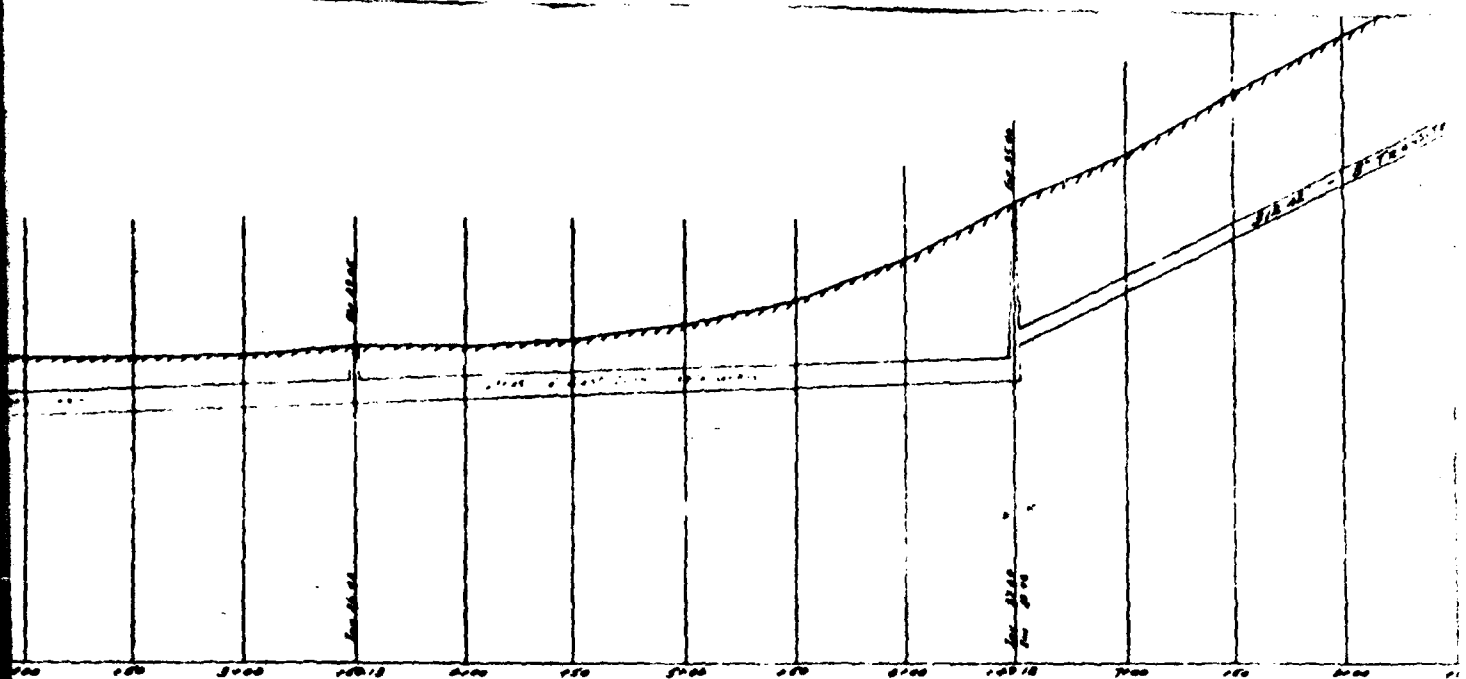
2

1879 1885
Sec. 2 Plan



PLAN
 OF
 SYLVAN STREET
 DARTMOUTH MASS
 SURVEYED JULY 1879
 BY
 ANDREW T. HAYES
 DARTMOUTH COLLEGE

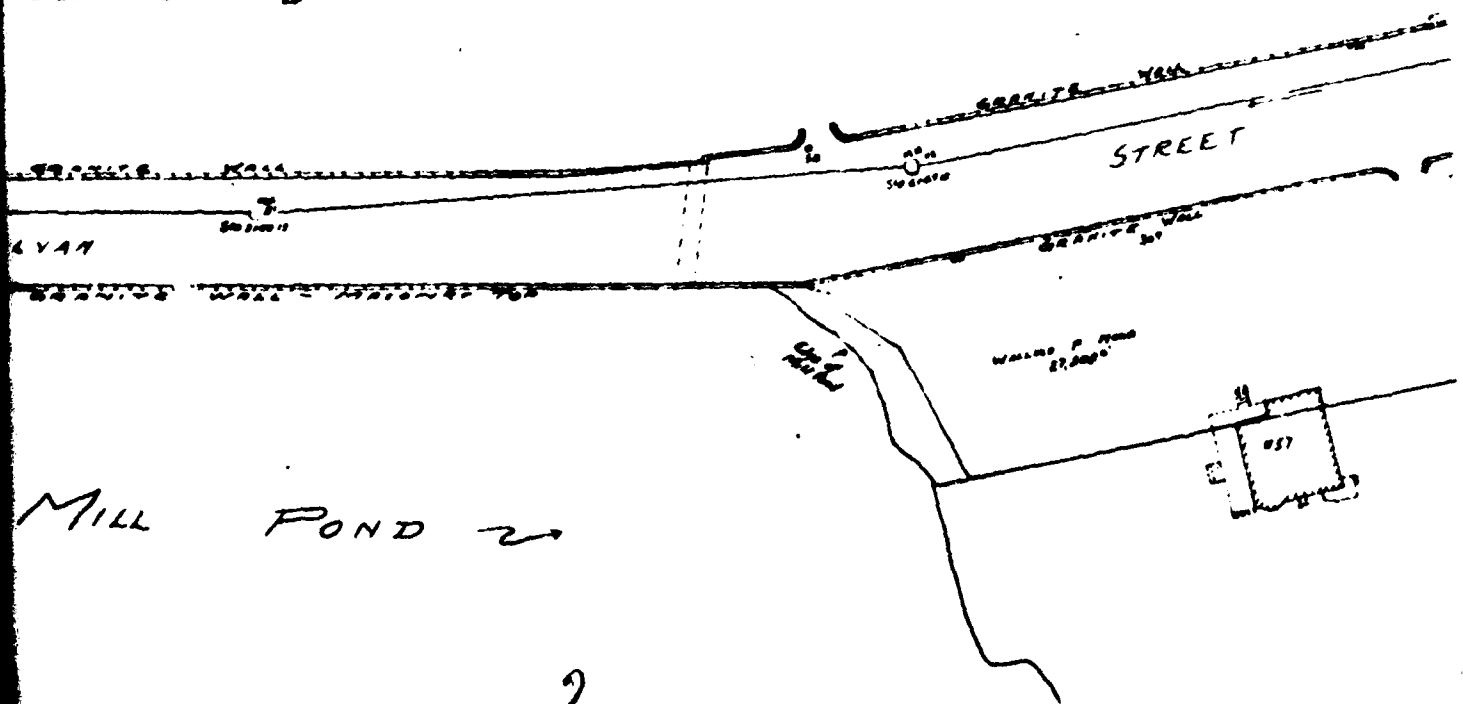
Copy of Plan in file in Office of Clerk of Court
 C. H. 158 H. 11. 1888
 Traced and checked by C. D. Brown Apr 20 1891
 No checked by A. H. 158 H. 11. 1888



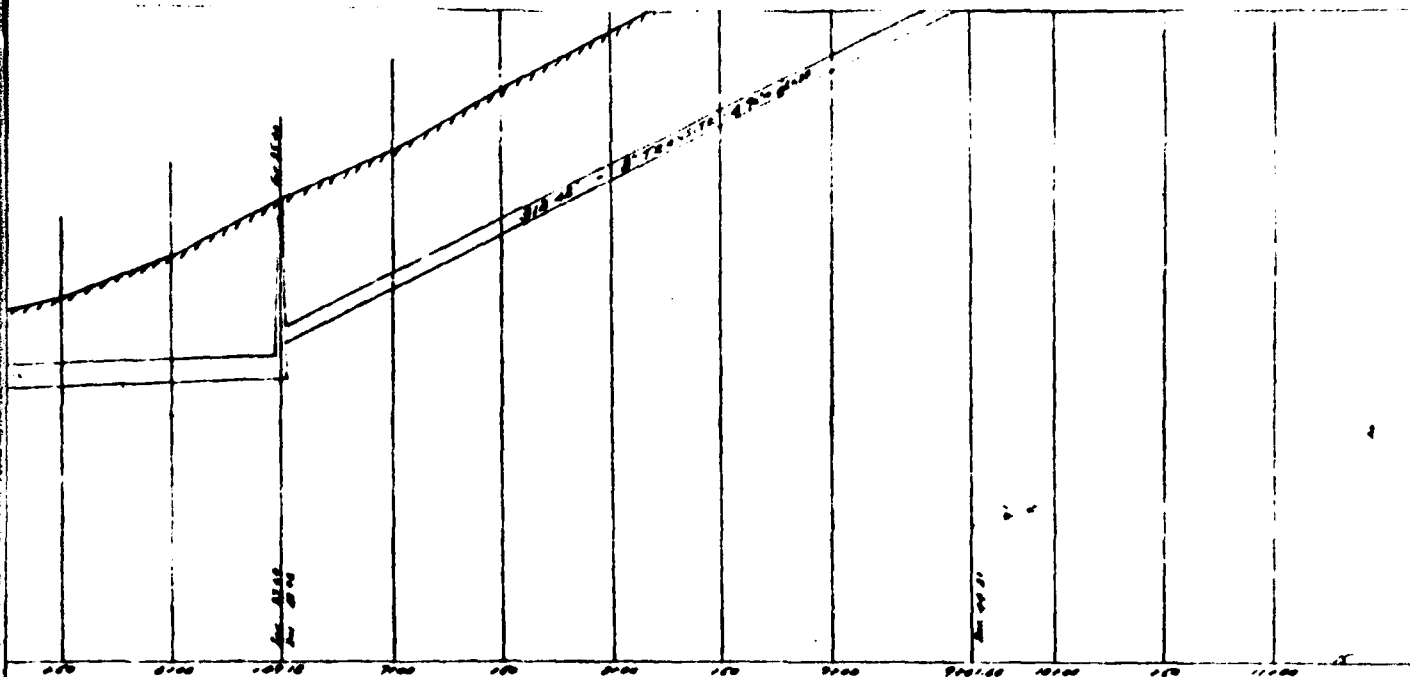
PROFILE SCALE
HOR 1"=40' VERT 1"=4'

PLAN SCALE - 1"=40'

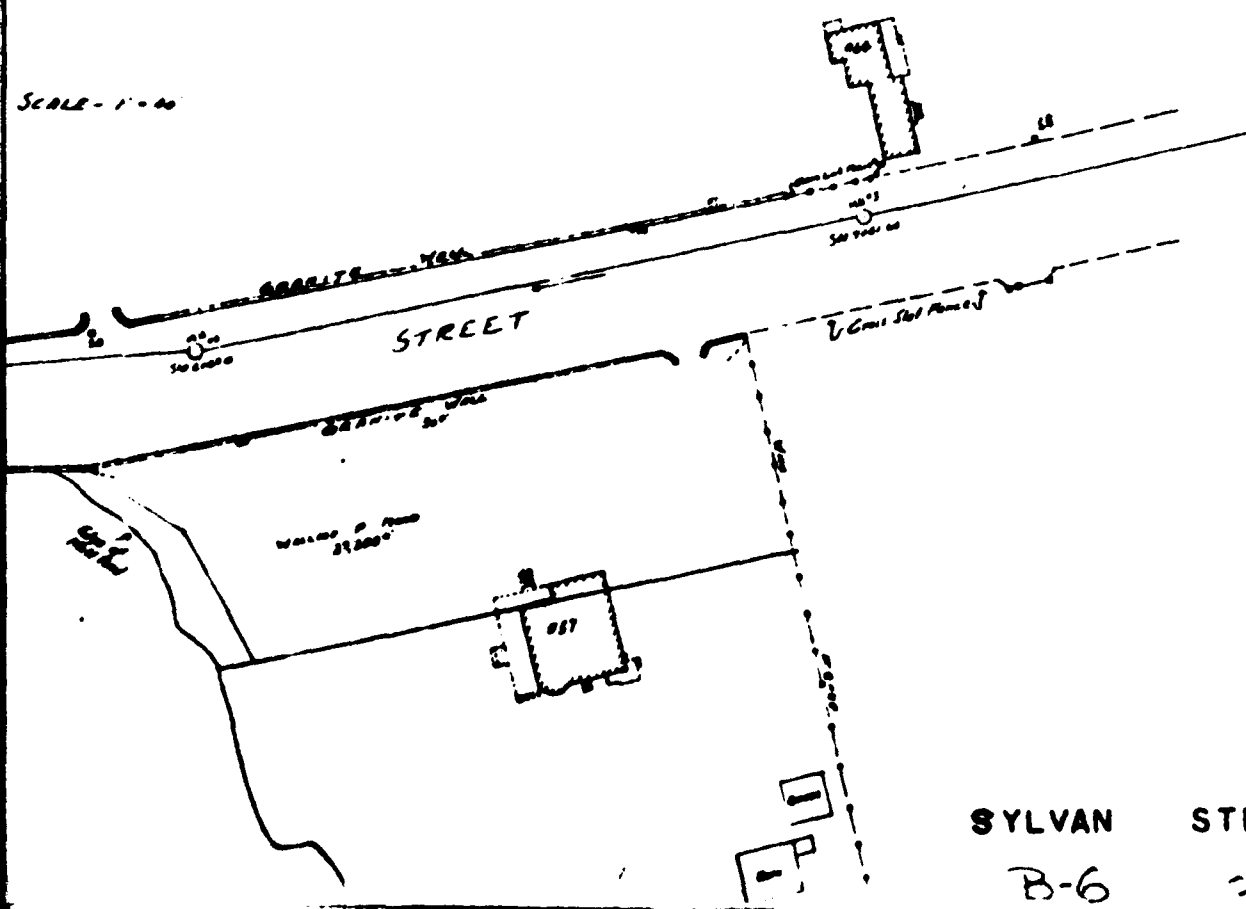
CEMETERY 2



MILL POND 2



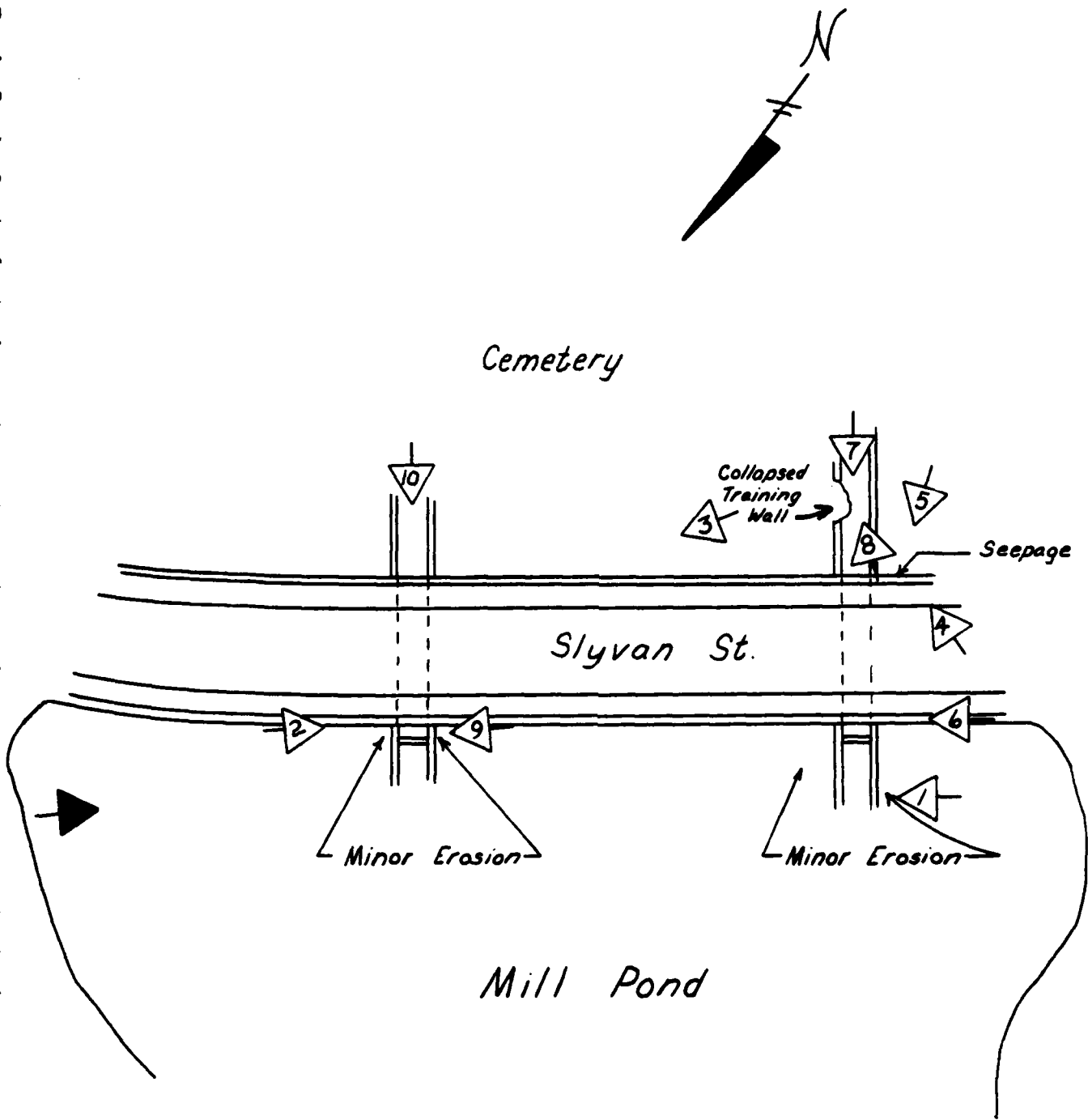
PROFILE SCALE
VERT 1"=4'



SYLVAN STREET
B-6 2 2428-6

Appendix C

Photos



- ➡ Overview Photo
- ➡ Appendix "C" Photo

C-1

LOUIS BERGER & ASSOC., INC. WELLESLEY, MASS. ARCHITECT · ENGINEER		U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
MILL POND DAM			
SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS			
STATE - MA.			
		SCALE NOT TO SCALE	
		DATE	

MILL POND DAM

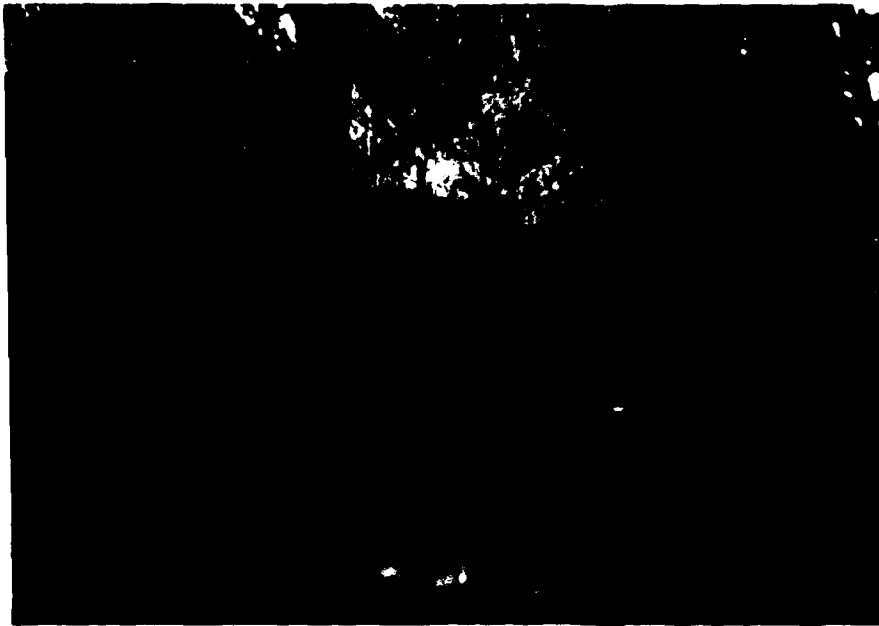


1. Upstream slope and crest of dam from right abutment.

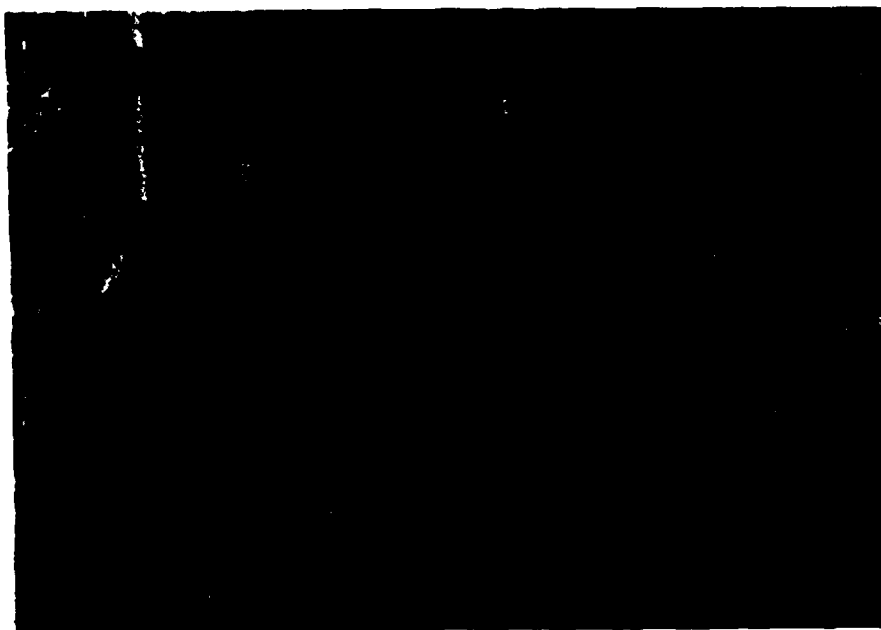


2. Upstream slope and crest of dam from left abutment.

MILL POND DAM

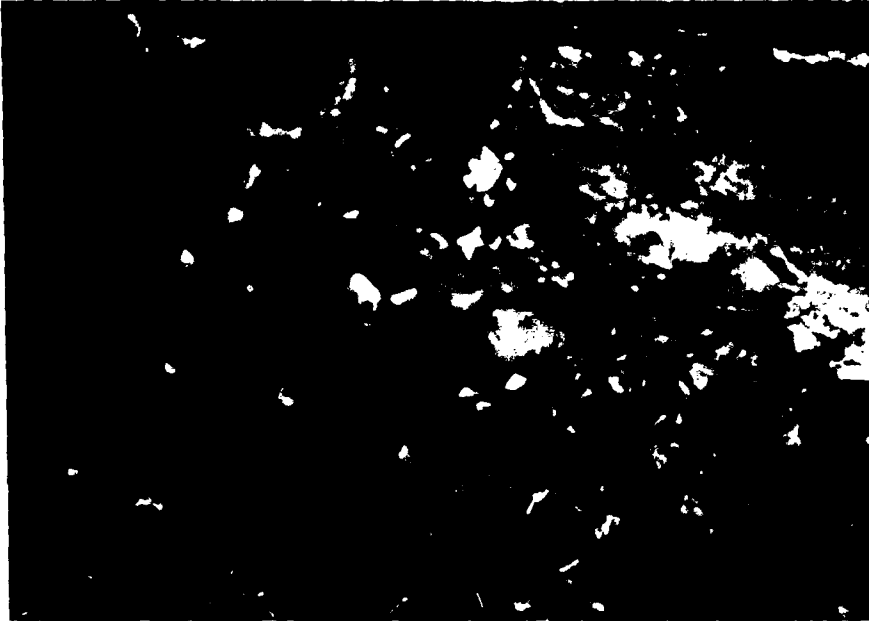


3. Downstream ashlar masonry wall.



4. Missing mortar from upstream joints of ashlar masonry wall.

MILL POND DAM



5. Seepage at downstream toe of ashlar masonry wall about 10 ft. right of right outlet channel.

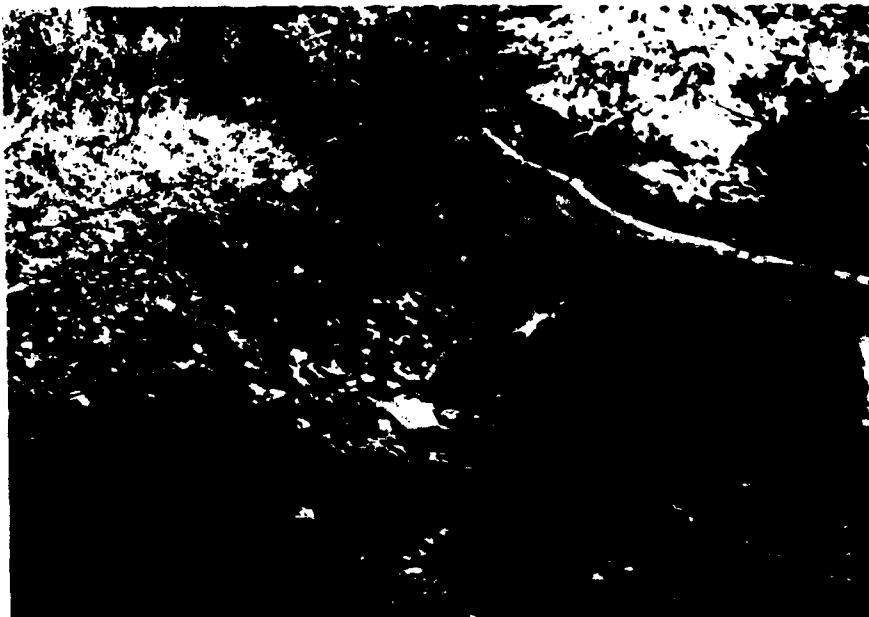


6. Upstream end of right outlet structure (primary spillway).

MILL POND DAM



7. Downstream end of right outlet structure (primary spillway).



8. Deteriorated downstream outlet channel (right) training wall.

MILL POND DAM



9. Upstream face of left outlet structure (secondary spillway).



10. Downstream end of left outlet structure (secondary spillway).

Appendix D

Hydrologic and Hydraulic Computations

BY RFB DATE 11-10-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 2

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND DAM, HYDROLOGY

FIND. DRAINAGE AREA:

SCALE 18 25,000

READ #2	52.86	READ #3	65.58	
" #1	<u>20.00</u>	" #2	<u>52.86</u>	AVE 32.79
	32.86		32.72	

$$\text{AREA} = 32.79 \times 0.1556 = 5.10 \text{ SQ. MI}$$

AREA @ NORMAL STORAGE (ELEV. 18.5 (WINTER & SPRING))

READ #2	24.13	READ #3	24.18	
" #1	<u>24.07</u>	" #2	<u>24.13</u>	AVE 0.055
	0.06		0.05	

$$\text{AREA} = 0.055 \times 99.58 = 5.48 \text{ ACRES}$$

AREA @ ELEV. 20

READ #2	25.73	READ #3	25.85	
" #1	<u>25.61</u>	" #2	<u>25.73</u>	AVE 0.12
	0.12		0.12	

$$\text{AREA} = 0.12 \times 99.58 = 11.95 \text{ ACRES}$$

AREA @ ELEV. 30

READ #2	38.70	READ #3	39.76	
" #1	<u>37.64</u>	" #2	<u>38.70</u>	AVE 1.06
	1.06		1.06	

$$\text{AREA} = 1.06 \times 99.58 = 106 \text{ ACRES}$$

BY RFB DATE 11-10-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 2

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND - DANVERS

HYDROLOGY

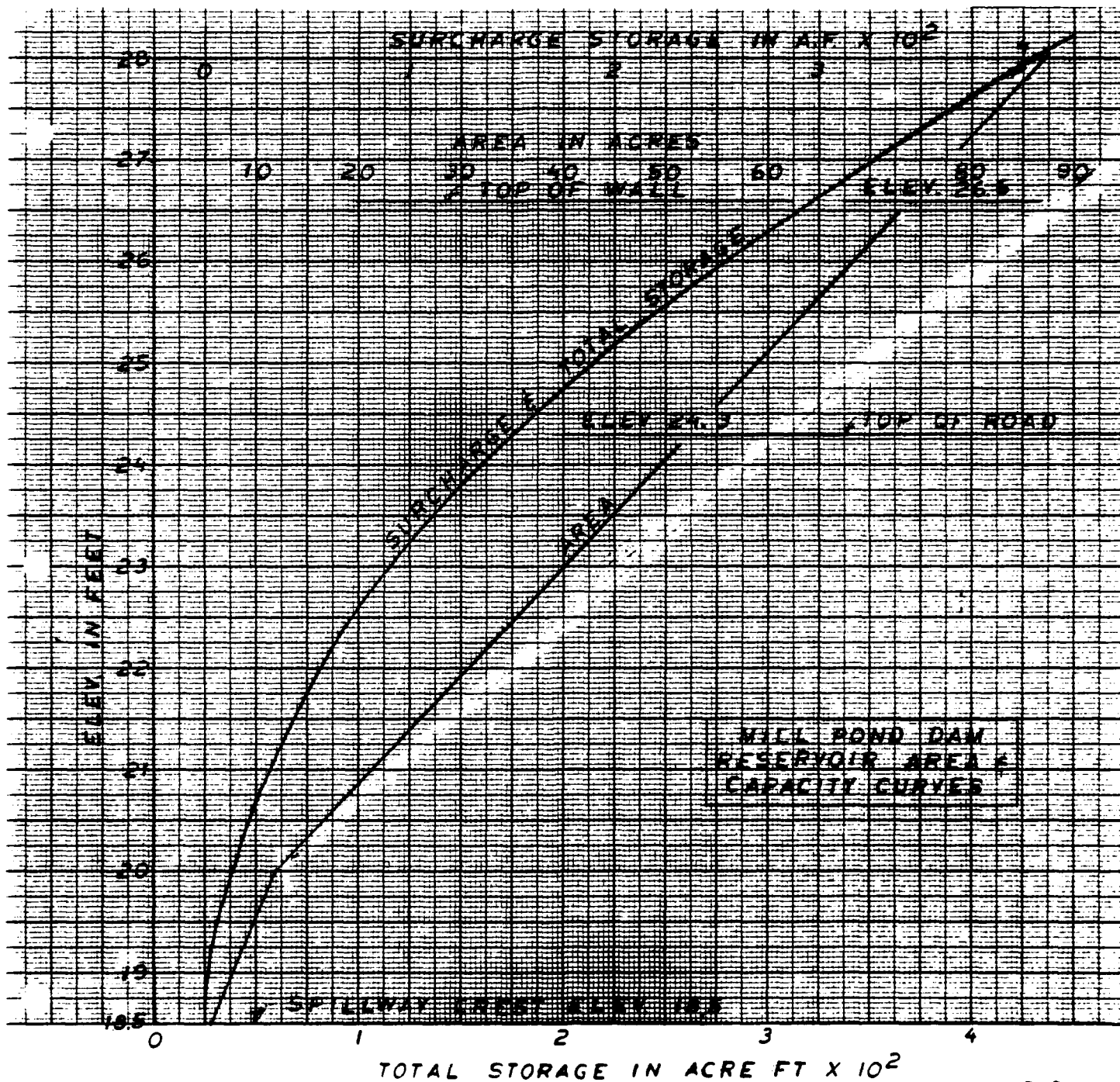
WATER DEPTH BELOW SPILLWAY CREST = 7.8 FT

STORAGE @ ELEV. 18.5: $V = \frac{1}{2} h A = \frac{1}{2} (7.8) (5.5)$

$V = 22.4$ ACRE-FT

SAY: $V = 25$ ACRE-FT

ELEV	AREA	AVE AREA	H	Δ VOLUME	TOTAL STORAGE	SURCHARGE STORAGE
18.5	5.5				25.0	
20.0	12.0	8.8	1.5	13.2	38.2	13.2
22	30.8	21.4	2	42.8	81.0	56.0
24	49.6	40.2	2	80.4	161.4	136.4
26	68.4	59.0	2	118.0	279.4	254.4
28	87.2	77.8	2	155.6	435.0	410.0
30.0	106	96.6	2	193.2	628.2	603.2



BY RFB DATE 11-6-80

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 3

CHKD. BY _____ DATE _____

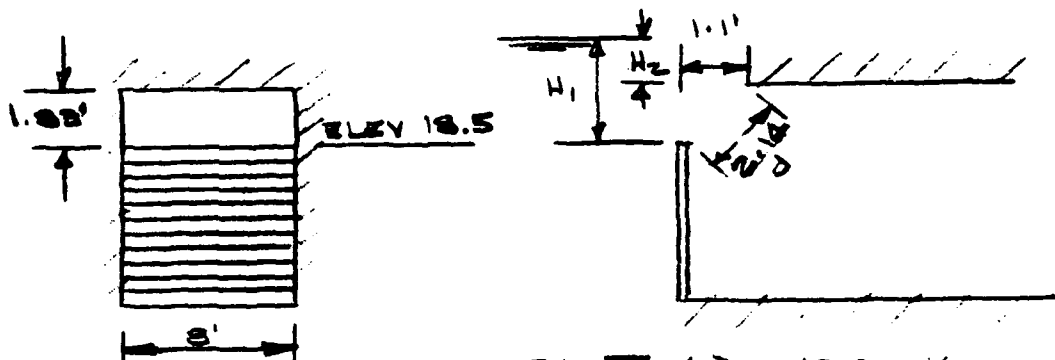
PROJECT W-198

SUBJECT MILL POND DAM, DANVERS

CAPACITY CURVES

DISCHARGE THROUGH PRINCIPAL SPILLWAY

ASSUME STOPLOGS AT ELEV. 18.5 FT



$$2/3 \sqrt{2g} (8) = 42.8 = K$$

ASSUME ORIFICE FLOW WHEN HEAD = 2.4

& FORMULA $Q = 3/5 \sqrt{2g} CL (H_1^{3/2} - H_2^{3/2})$ APPLIES

C FROM FIG. 257, DESIGN OF SMALL DAMS

ELEV.	H ₁	H ₂	d/H ₁	C	H ₁ ^{3/2} - H ₂ ^{3/2}	K	Q
18.5							0
21.5	3	1.2	0.71	0.64	3.88	42.8	106
22.5	4	2.2	0.53	0.66	4.74		133
23.5	5	3.2	0.43	0.67	5.46		157
24.3	5.8	4.0	0.37	0.68	5.96		173
25.3	6.8	5.0	0.31	0.69	6.55		193
26.6	8.1	6.3	0.26	0.69	7.24		214
27.1	8.6	6.8	0.25	0.69	7.48		221
27.6	9.1	7.3	0.24	0.69	7.72		228
28.1	9.6	7.8	0.22	0.70	7.96		238
28.6	10.1	8.3	0.21	0.70	8.19		245
29.1	10.6	8.8	0.20	0.70	8.41		252
29.6	11.1	9.3	0.19	0.70	8.62		258

BELOW ELEV 21.5 & ELEV 20

$$Q = CLH^{3/2} = 3.2(8)(1.5)^{3/2} = 47$$

BY RFB DATE 11-10-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 3

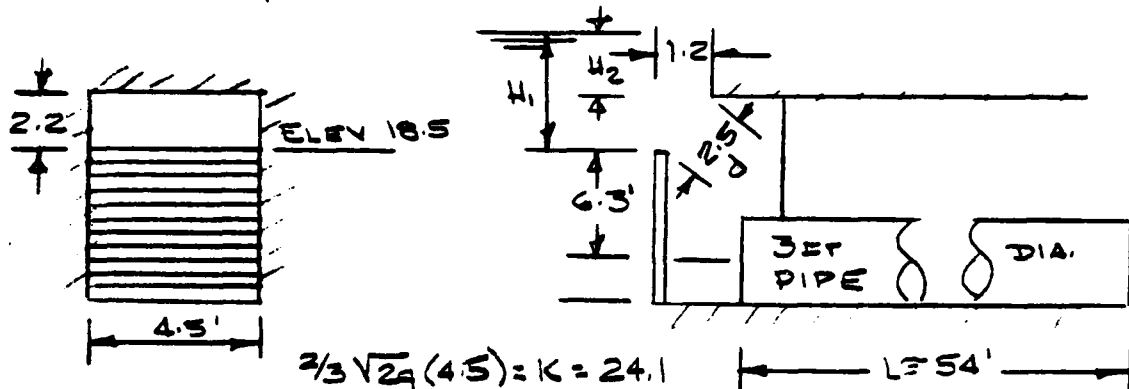
CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND DAM, DANVERS

CAPACITY CURVES

DISCHARGE THROUGH AUXILIARY SPILLWAY
ASSUME STOPLOGS AT ELEV. 18.5 FT



SEE WHAT GOVERNS @ ELEV. 21.5 PIPE OR STOPLOGS
(STOPLOGS GOVERN)

FOR WEIR

ELEV.	H ₁	H ₂	d/H ₁	C	H ₁ ^{3/2} - H ₂ ^{3/2}	K	Q
21.5	3	0.8	0.83	0.64	4.48	24.1	69
22.5	4	1.8	0.62	0.66	5.58		89
23.5	5	2.8	0.50	0.67	6.49		105
24.3	5.8	3.6	0.43	0.67	7.14		115
25.3	6.8	4.6	0.37	0.68	7.87		129
26.6	8.1	5.9	0.31	0.69	8.72		145
27.6	9.1	6.9	0.27	0.69	9.33		155
28.6	10.1	7.9	0.25	0.69	9.89		164
29.6	11.1	8.9	0.22	0.70	10.43		176

BELOW ELEV. 21.5 @ ELEV 20

$$Q = CLH^{3/2} = 3.2(4.5)(1.5)^{3/2} = 26$$

CHECK PIPE @ ELEV 28.6 & 29.6

$$Q = A\sqrt{\frac{2gh}{K}}$$

$$K = 0.5 + 1.0 + \frac{2L}{D}$$

$$K = 0.5 + 1.0 + \frac{0.83(54)}{3}$$

$$K = 1.95$$

ELEV. 28.6

$$Q = 7.06 \left(\frac{64.4 \times 16.4}{1.95} \right)^{1/2} = 164$$

STOPLOGS GOVERN

ELEV. 29.6

$$Q = 7.06 \left(\frac{64.4 \times 17.4}{1.95} \right)^{1/2} = 169$$

PIPE GOVERNS

D-5

BY RFB DATE 11-10-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 3 OF 3

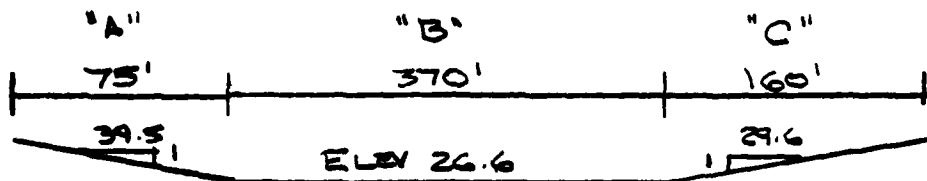
CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND, DANVERS

CAPACITY CURVES

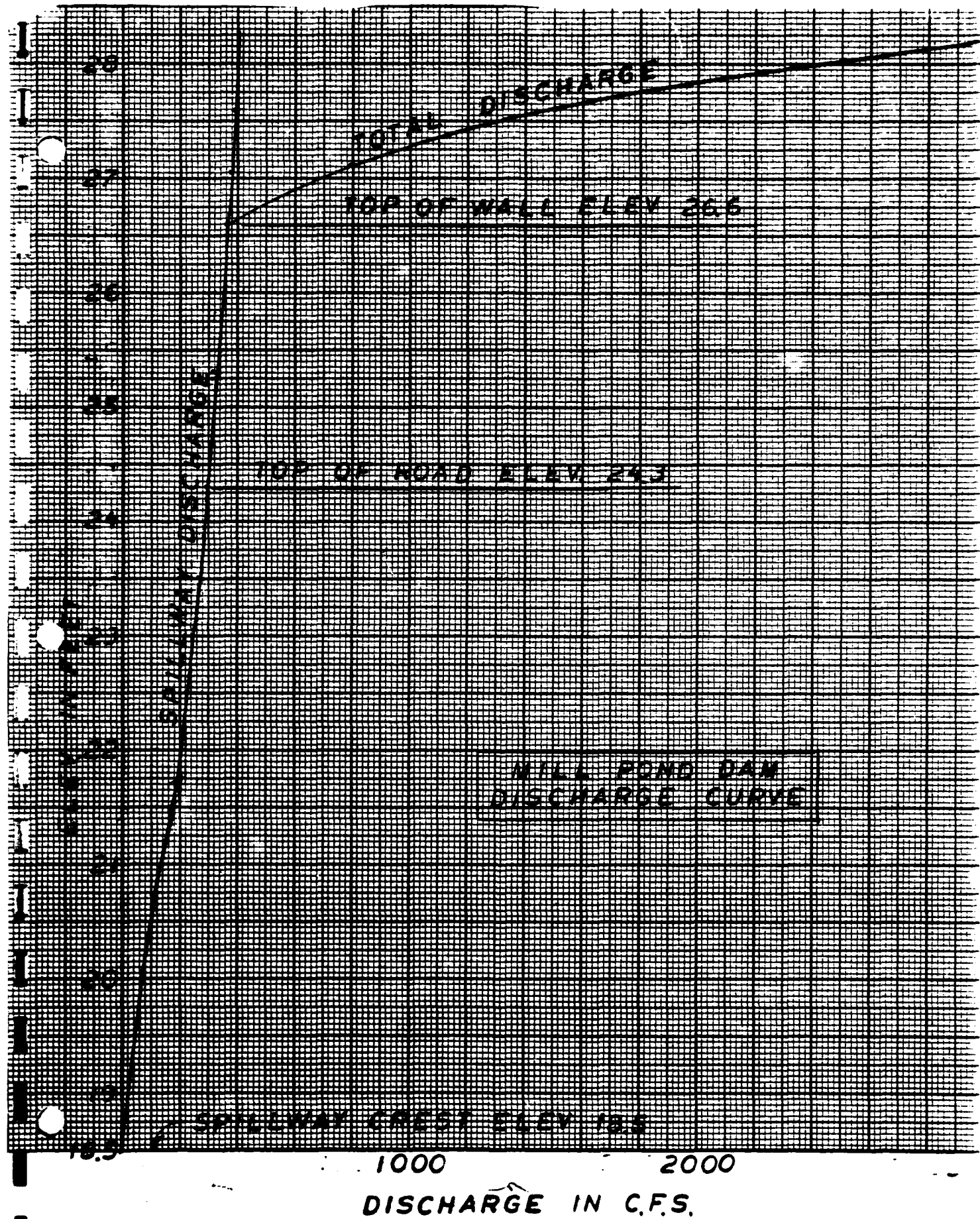
DISCHARGE OVER WALL



ELEV	"A", C=3.1			"B", C=3.1			"C", C=3.1			ΣQ
	H	L	Q	H	L	Q	H	L	Q	
26.6	0	—	0	0	—	0	0	—	0	0
27.1	.25	20	8	.5	370	405	.25	15	6	419
27.6	.5	40	44	1		1147	.5	30	33	1224
28.1	.75	60	121	1.5		2107	.75	45	91	2319
28.6	1	80	248	2		3244	1	60	186	3678
29.1	1.25	100	438	2.5		4534	1.25	75	325	5292
29.6	1.5	120	683	3		5960	1.5	90	512	7155

TOTALS

PRIMARY SPILLWAY	AUXILIARY SPILLWAY	OVER WALL	TOTAL Q	ELEV
0	0	0	0	18.5
47	26	0	73	20
106	69	0	175	21.5
133	89	0	222	22.5
137	105	0	242	23.5
173	115	0	288	24.3
193	123	0	316	25.3
214	145	0	359	26.6
221	150	419	790	27.1
228	155	1224	1607	27.6
238	160	2319	2717	28.1
245	164	3678	4087	28.6
252	169	5292	5713	29.1



BY RFB DATE 11-5-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 3

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND - DANVERS

INLEW HYDROGRAPH

DRAINAGE AREA (TOTAL) = 5.10 sq. mi

By inspection RESERVOIR AREA < 25% D.A.

LENGTH OF LONGEST WATER COURSE, $L = 18,900$
 $L = 3.58$ MI

ELEVATION DIFFERENCE = $130 - 118.5 = 11.5$

\therefore SLOPE = $\frac{11.5}{18,900} = 40.1 \text{ FT/MI} \approx \sqrt{3} = 6.33$

Now $\frac{LLC}{\sqrt{S}} = \frac{(3.58)(2.46)}{6.33} = 1.39$

$\left(\frac{LLC}{\sqrt{S}}\right)^{.33} = (1.39)^{.33} = 1.11$

$LAG = K \left(\frac{LLC}{\sqrt{S}}\right)^{.33} = 1.11 K$

Assume $K = 7.5$

$LAG = 1.11(7.5) = 8.32$ HOURS

$T_p = 0.41D + 0.82 LAG$, WHERE $D = 1.0$ HRS

$T_p = 0.41(1) + 0.82(8.32)$

$T_p = 7.23$ HRS

CHECK VELOCITY

$T_c = \frac{T_p - .5D}{0.6}$

$T_c = \frac{7.23 - .5}{0.6} = 11.4$

$V = \frac{18,900}{11.4 \times 5280} = 0.46 \text{ FT/SEC}$ O.K.

BY RFB DATE 11-6-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 3

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND DAM - DANVERS INFLOW HYDROGRAPH

$$T_R = 1.67 T_P = 1.67 (7.23) = 12.07$$

$$T_B = T_P + T_D = 7.23 + 12.07 = 19.3$$

q_p = PEAK RATE IN CFS

$$q_p = \frac{484 A Q}{T_P}$$

A = DRAWAGE AREA

Q = RUNOFF IN INCHS

$$q_p = \frac{484 (5.10) (1)}{7.23} = 341 \text{ CFS}$$

PMP = PROBABLE MAXIMUM PRECIPITATION

$$= 25'' (0.8) = 20''$$

= 19.6'' CONSIDERING INFILTRATION FOR
OVERLAND FLOW

BY REB DATE 11-6-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 3 OF 3

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND - DANVERS IN FLOW HYDROGRAPH

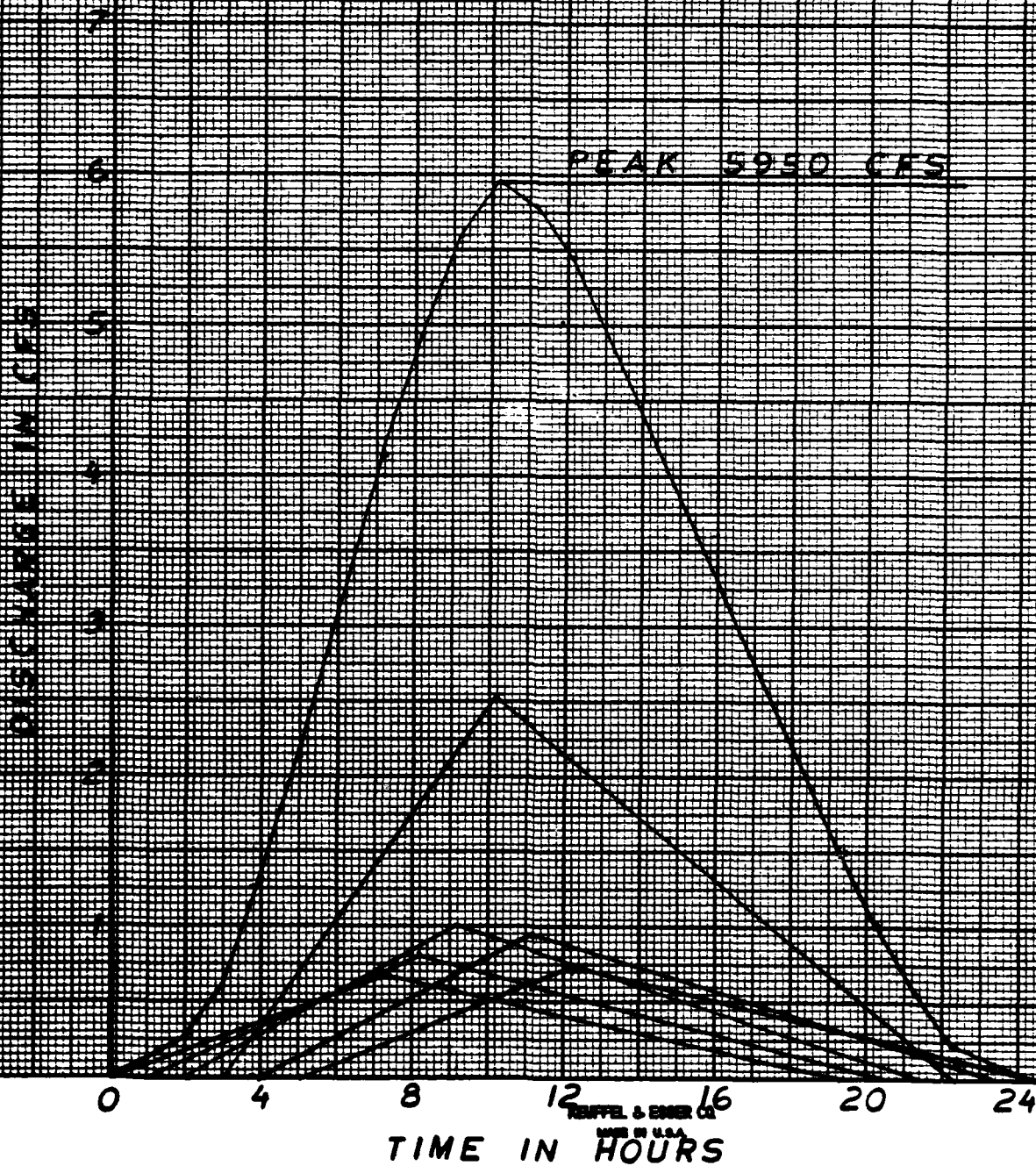
FLOOD HYDROGRAPH FOR PMF

$Q_p = 341 \text{ cfs}$

TIME (HOURS)	RAINFALL		Qp CFS	TIME		
	%	INCHS		BEGIN	PEAK	END
0.0	-					
1.0	10	1.96	668	0	7.2	19.3
2.0	12	2.35	801	1.0	8.2	20.3
3.0	15	2.94	1002	2.0	9.2	21.3
4.0	30	7.45	2540	3.0	10.2	22.3
5.0	14	2.74	934	4.0	11.2	23.3
6.0	11	2.16	737	5.0	12.2	24.3

* DISTRIBUTION OF MAXIMUM 6 HOUR PMP
IN PERCENT OF 6 HOUR AMOUNT PER
EM 1110-2-1411

MILL POND DAM INFLOW HYDROGRAPH FULL PMF



BY RFB DATE 11-10-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 2

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND DAM

RESERVOIR ROUTING

DRAINAGE AREA = 5.1 sq mi = 3264 ACRES

SIZE CLASSIFICATION - SMALL

MAX STORAGE = 322 ACRE-FT

HEIGHT = 26.6 - 14 = 12.6 FT

HAZARD CLASSIFICATION = High

OCE GUIDELINES, USE $\frac{1}{2}$ PMF TO PMF

TEST FLOOD = $\frac{1}{2}$ PMF

PMF = 5,950

$\frac{1}{2}$ PMF = 2,975 CFS

STEP 1: $Q_{P1} = 2,975$ CFS

STEP 2a: ELEV. = 28.2

STEP 2b: SURCHARGE VOLUME = 422 A.F.

$$\text{INCHS RUNOFF} = \frac{422 \text{ A.F.}}{3264 \text{ ACRES}} \times 12 \text{ W/FT} = 1.55 \text{ IN}$$

STEP 2c: $Q_{P2} = 2975 \left(1 - \frac{1.55}{9.5}\right)$

$Q_{P2} = 2490$ CFS

STEP 3a: FOR $Q = 2490$

SURCHARGE HEIGHT = 28.02

SURCHARGE VOLUME = 405

$$\text{INCHS OF RUNOFF} = \frac{405 \times 12}{3264} = 1.49 \text{ IN.}$$

BY RFB DATE 11-14-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 2

CHKD. BY _____ DATE _____

PROJECT W-19B

SUBJECT MILL POND DAM

RESERVOIR ROOFING

STEP 3b

$$\text{AVE STORAGE} = \frac{1.55 + 1.49}{2} = 1.52 \text{ IN}$$

2ND ITERATION

$$\text{STEP 2c } Q_{p2} = 2975 \left(1 - \frac{1.52}{9.5}\right)$$

$$Q_{p2} = 2500 \text{ CFS}$$

STEP 3a FOR $Q = 2500 \text{ CFS}$

$$\text{SURCHARGE HEIGHT} = 28.03$$

$$\text{SURCHARGE VOLUME} = 408$$

$$\text{INCHS RUNOFF} = \frac{408 \times 12}{3264} = 1.50$$

$$\text{STEP 3b } \overline{\text{STOR}} = \frac{1.52 + 1.50}{2} = 1.50$$

$$\text{AVE SURCHARGE VOL} = \frac{1.50 \times 3264}{12} = 408 \text{ A.F.}$$

$$\text{SURCHARGE HEIGHT} = 28.03$$

$$Q_{p3} = 2500 \text{ CFS}$$

$$\frac{1}{2} \text{ PMF OVERTOPS WALL BY } 28.03 - 26.6 = 1.43 \text{ FT}$$

$$\text{SAY } Q_{\text{OUP}} = 2,500 \text{ CFS}$$

$$\text{OVERTOPPING BY } 1.4 \text{ FT}$$

BY REB DATE 11-14-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 4

CHKD. BY DATE

PROJECT N-38

SUBJECT MILL POND DAMS , FAILURE ANALYSIS

COMPUTE BREACH Q , MAX $\Sigma = 322$ A.F.

HEIGHT = 12.6 FT

LENGTH @ MID HEIGHT = 375'

$W = 20\% \text{ of } 375 = 75'$

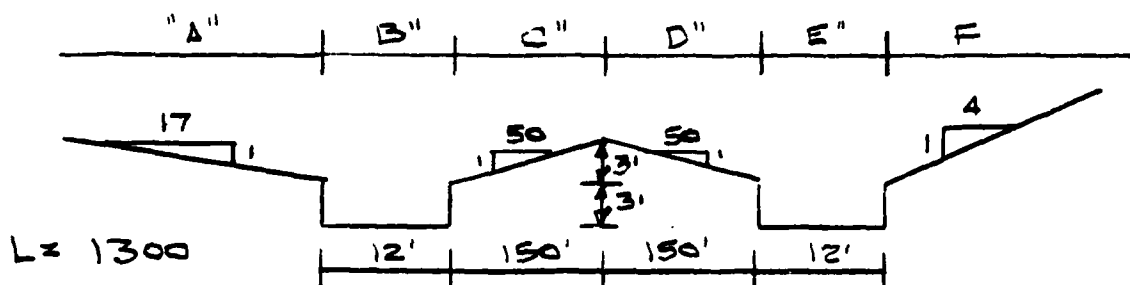
$$Q = 8/27 W \sqrt{2g} H^{3/2}$$

$$Q = 1.68 (75) (12.6)^{3/2} = 3635$$

$$Q_{\text{SPILLWAY}} \approx 360$$

SAY TOTAL Q = 6,000 CFS

REACH #1 , DAM TO ASH ST (FOR VOLUME ONLY)



STAGE	AREAS						
FT	A	B	C	D	E	F	TOTAL
1.5	0	18	0	0	18	0	36
3.0	0	36	0	0	36	0	72
4.5	19	54	56	56	54	4	243
6	76	72	225	225	72	18	688
7.5	172	90	450	450	90	40	1292
9	306	108	675	675	108	72	1944

BY REB DATE 11-14-80 LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 4

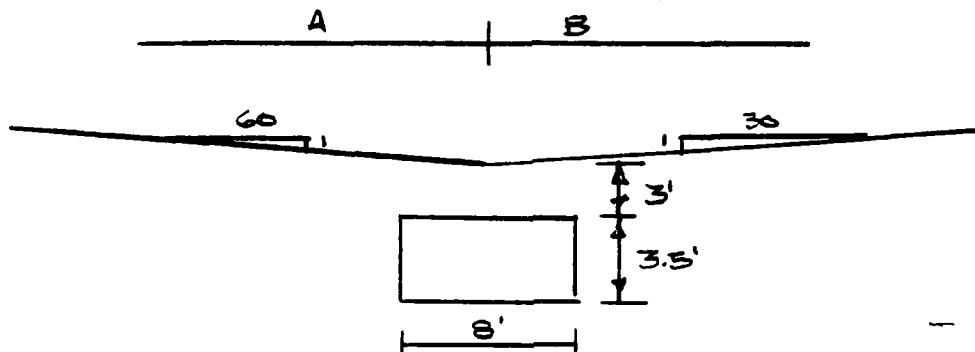
CHKD. BY _____ DATE _____

PROJECT 11-149

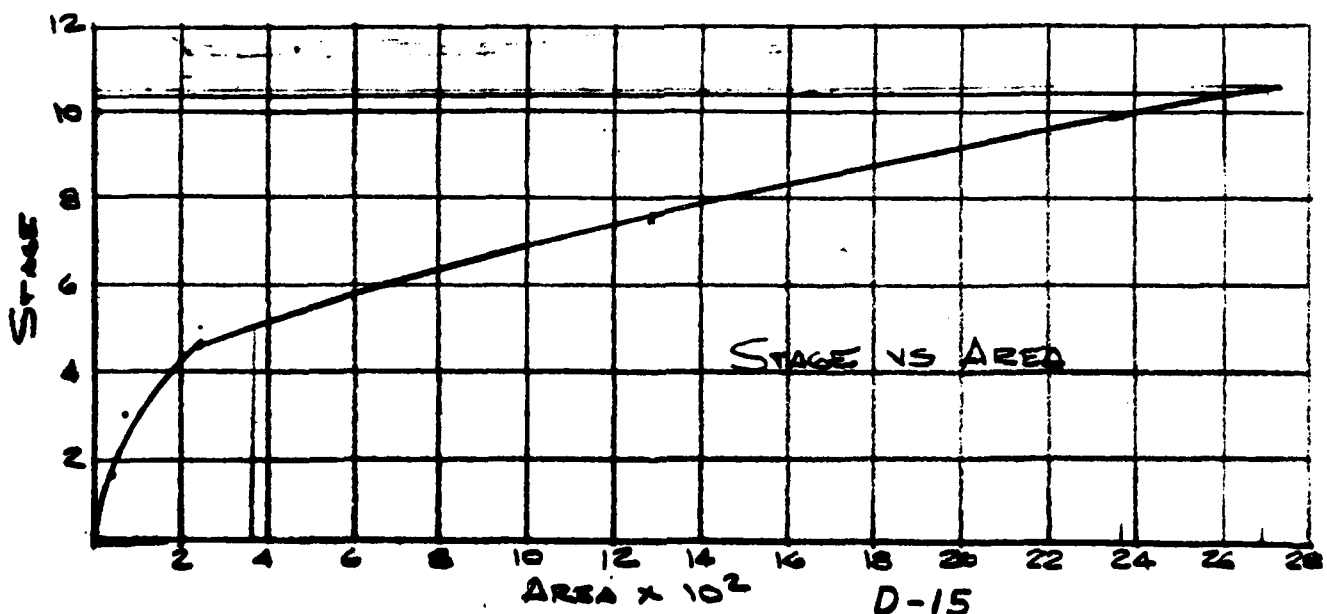
SUBJECT MILL POND, DANVERS

FAILURE ANALYSIS

REACH #1 - CULVERT JUST UP STREAM FROM
ASH ST, FOR DISCHARGE ONLY
L=1400'
ASSUME INLET CONTROL & WEIR FLOW



STAGE	CULVERT		WEIR A, C=2.3			WEIR B, C=2.3			TOTAL
	HW/D	Q	H	L	Q	H	L	Q	Q
3.5	1	132	0		0	0		0	132
5.0	1.43	216	0		0	0		0	216
6.5	1.86	280	0		0	0		0	280
7.0	2.0	296	.25	30	8	.25	15	4	308
8	2.29	320	.75	90	134	.75	45	67	521
9	2.57	344	1.25	150	482	1.25	75	241	1067
10	2.86	376	1.75	210	1118	1.75	105	559	2053
11	3.14	400	2.25	270	2096	2.25	135	1048	3544
12	3.43	430	2.75	330	3461	2.75	166	1741	5632



D-15

BY REB DATE 11-14-80 LOUIS BERGER & ASSOCIATES INC.

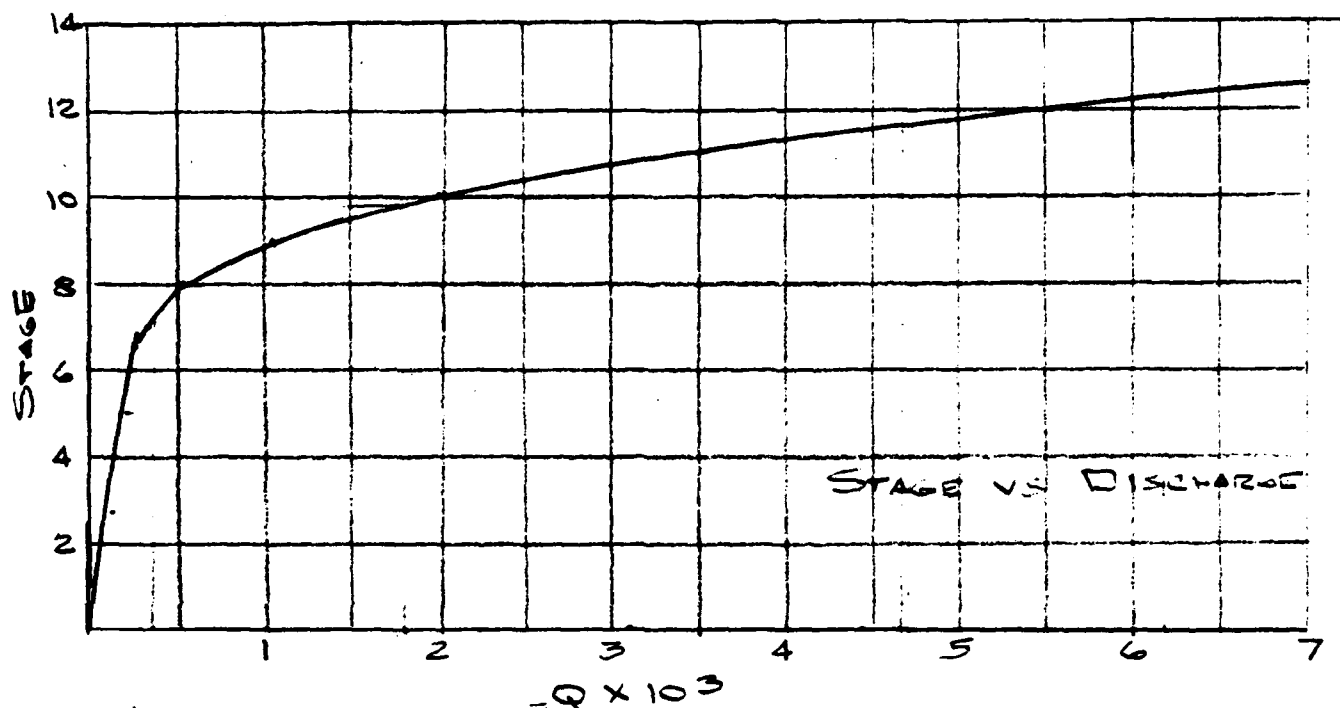
SHEET NO. 3 OF 4

CHKD. BY _____ DATE _____

PROJECT W-198

SUBJECT MILL POND, DANVER, VT

FAILURE ANALYSIS



SAY AVERAGE PREFAILURE STAGE $\frac{7.0 + 3}{2} = 5.0'$

AREA = 3600 \square

$\frac{2}{3}$ OF 12.6 FT = 8.4 FT

SAY AVERAGE POSTFAILURE STAGE = $\frac{12.2 + 8.4}{2} = 10.3'$

AREA = 2600 \square

$$\Delta V_1 = \frac{2600 + 3600}{43,560} \times 1400 = 72 \text{ ACRE-FT}$$

$$Q_{P2}(\text{TRIAL}) = 6,000 \left(1 - \frac{72}{322}\right)$$

$$Q_{P2}(\text{TRIAL}) = 4660 \text{ CFS}$$

FOR $Q = 4660$, STAGE = 11.6 FT

BY RFB DATE 11-14-80 LOUIS BERGER & ASSOCIATES INC.
CHKD. BY DATE
SUBJECT MILL POND, DANVERS

SHEET NO. 4 OF 4
PROJECT W-198
FAILURE ANALYSIS

FIND NEW POST FAILURE VOL. ΔV_2

$$\text{AVERAGE STAGE} = \frac{11.6 + 8.4}{2} = 10.0 \text{ FT}$$

$$\text{AREA} = 2,400 \text{ SQ. FT}$$

$$\Delta V_2 = \frac{2,400 - 360}{43,560} \times 1400 = 66 \text{ A.F.}$$

$$V_{AVE} = \frac{72 + 66}{2} = 69 \text{ A.F.}$$

$$Q_{P2} = \frac{6,000 \left(1 - \frac{69}{322}\right)}{1} = 4710 \text{ CFS}$$

$$\text{STAGE @ CULVERT} = 11.7 \text{ FT}$$

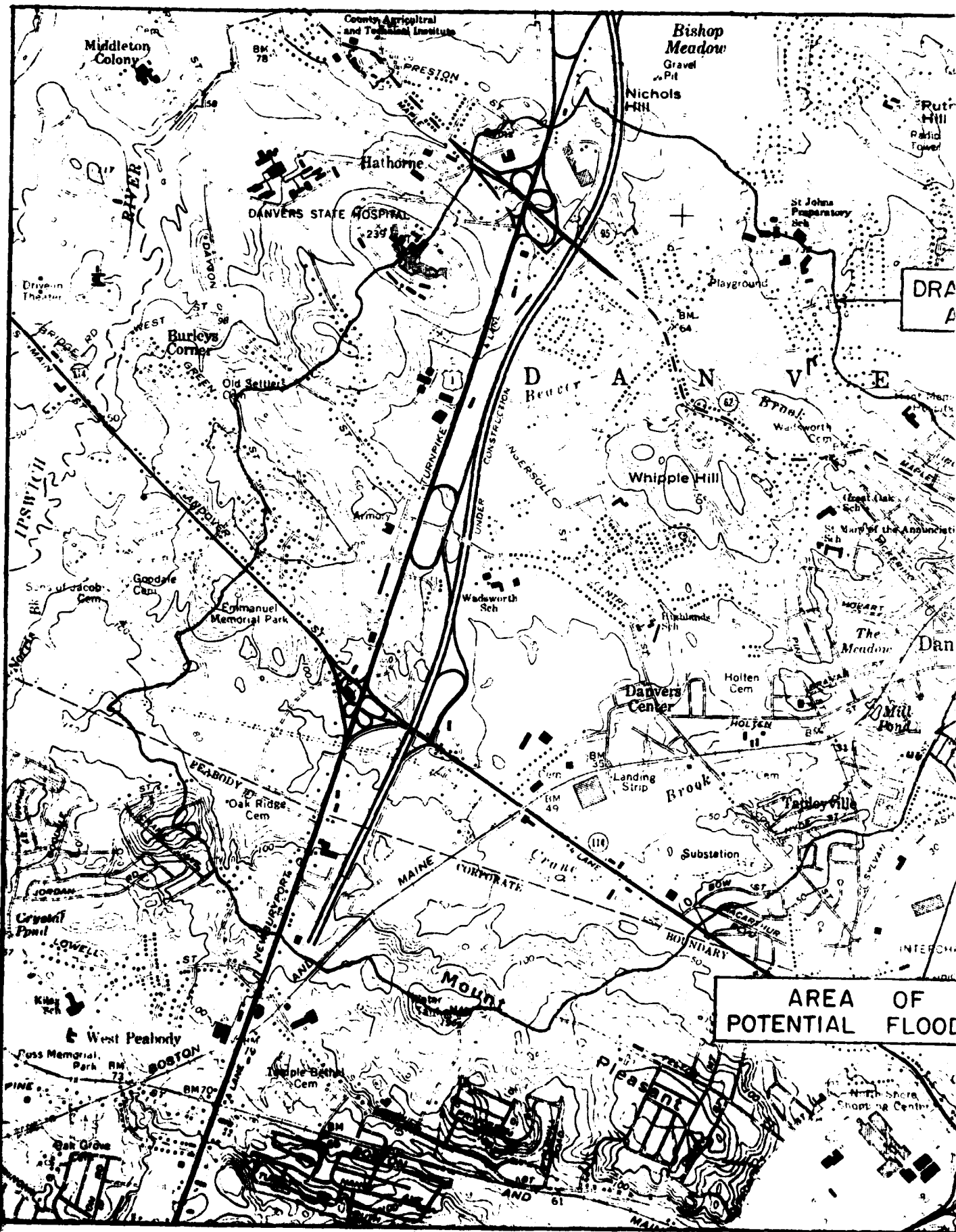
$$\text{DEPTH WATER OVER LOW POINT W ROAD} = 11.7 - 6.5 = 5 \text{ FT}$$

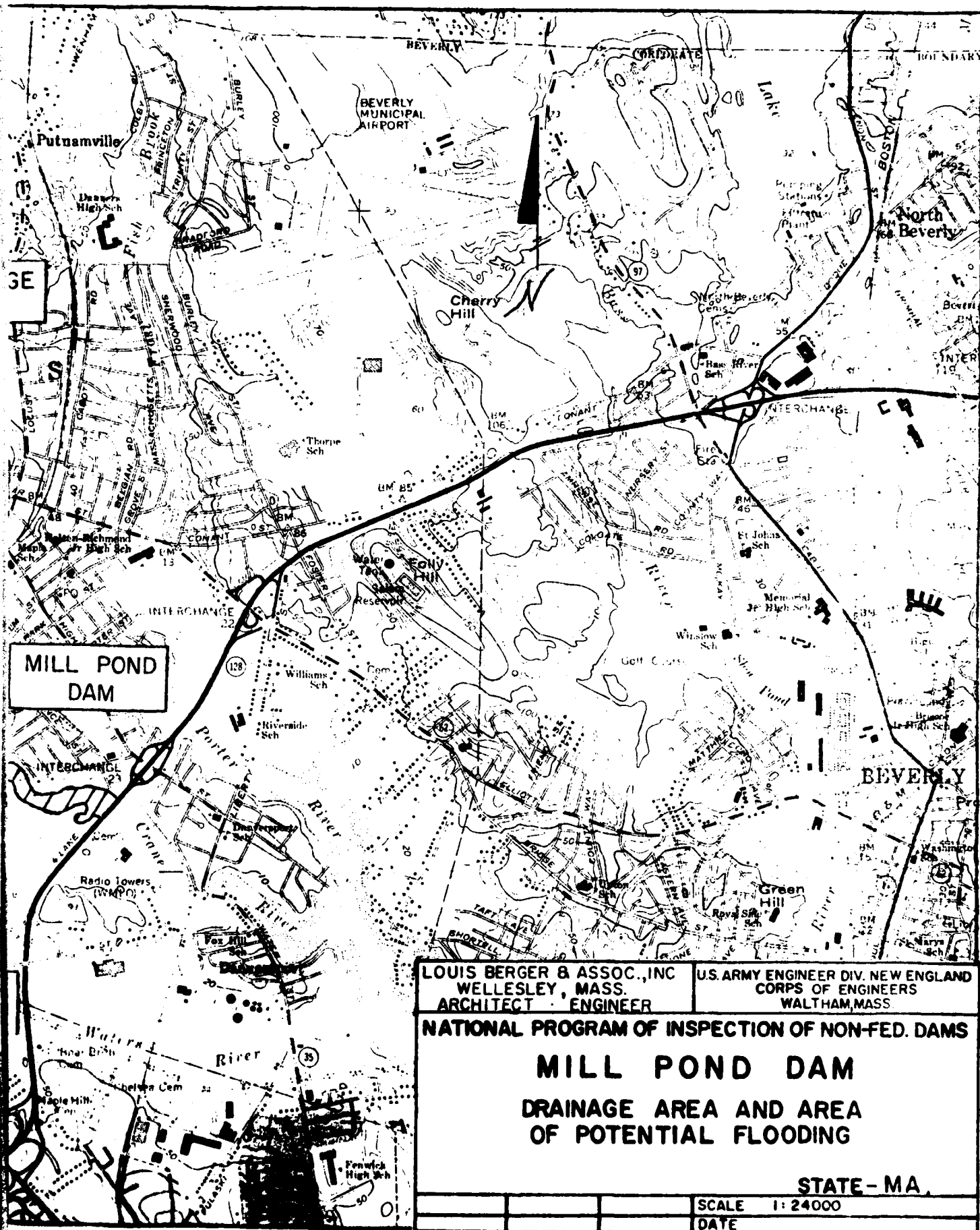
FOR SPILLWAY Q, STAGE WILL BE JUST 0.5 FT & OVER 1ST ST UPSTREAM OF ASH ST.

FOR BREACH Q, STAGE WILL BE ABOUT 5 FT OVER 1ST ST UPSTREAM OF ASH ST.

ESTIMATE OF POST FAILURE FLOODING

- 1) LOSS OF SYLVAN ST DUE TO BREACH
- 2) 5 HOODES 3 FT FLOODING
- 3) 1 APT HOODE 1ST WATER
- 4) 2 LOCAL STS TO 5 FT.





Appendix E
Information as Contained in the
National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

IDENTITY NUMBER	STATE	COUNTY	DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
161	MA	09	06	MILL POND DAM	233.6	7056.5	200CT80

POPULAR NAME	NAME OF IMPOUNDMENT	
	MILL POND	
REACH/STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	POPULATION
CRANE BROOK	DANVERS	26200

TYPE OF DAM	YEAR COMPLETED	PURPOSES	HYDRO. HEIGHT (FT.)	IMPOUNDING CAPACITIES (ACR.-FT.)	DIST. OWN.	FED. R.	PRV. F.	SCS A.	VER. DATE
ROOT	1875		13	322	25	N	E	D	

REMARKS									
21-STONE WALL DOWNSTREAM, 22-ESTIMATED									
D/S	SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CU YD)	POWER CAPACITY (KW)	INSTALLED	PROPOSED	NO.	LENGTH (FT.)	NAVIGATION LOCKS
1	530 U	13	400	5800					

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF DANVERS	UNKNOWN	UNKNOWN

REGULATORY AGENCY		
DESIGN	CONSTRUCTION	OPERATION
NONE	NONE	MA DEGE.

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
LOUIS BERGER & ASSOC INC	200CT80	PL 92-367

REMARKS